THE FOUNDRY

Established in 1892

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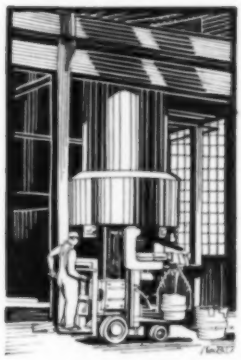

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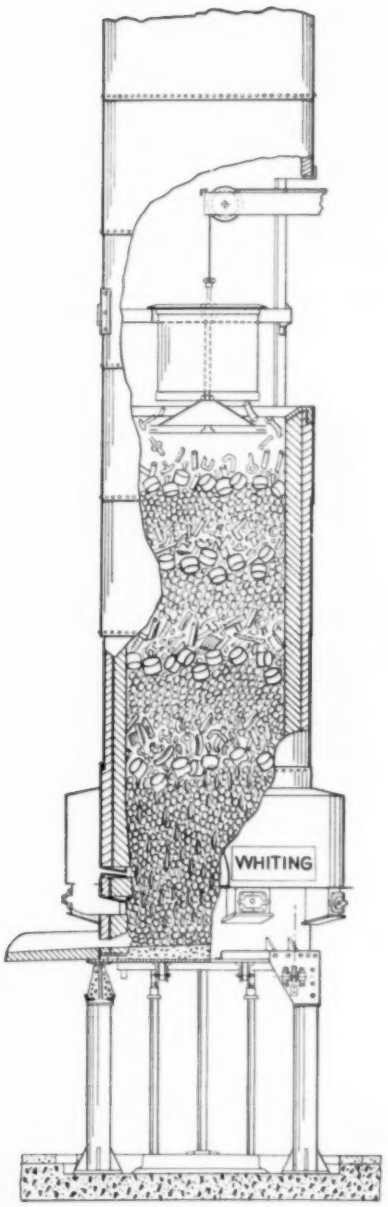
CUPOLA ALLOYS

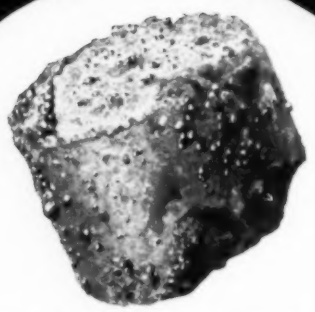
need INTERFERENCE, too

EXPECTING an unprotected alloy to reach the melting zone of a cupola uncontaminated is like expecting a fullback to make a touchdown without interference. It can be done, but with no high average of success.

But when you add silicon, manganese, or chromium in the form of E. M. Briquets, oxidation cannot "take it out of the play" because a refractory binder sheathes the alloy until it reaches the hottest zone. Then the binder disintegrates and releases the alloy at the point where it does the most good.

Each E. M. Briquet contains a fixed amount of silicon, manganese, or chromium, which is delivered without loss to the iron. As a result, recovery is higher and off-iron is prevented. If you want to simplify foundry practice and produce better castings at lower cost, ask Electromet Engineers to explain how E. M. Briquets can help you. A request today will bring you complete information.





This E. M. BRIQUET was removed just before entering the melting zone and shows how the alloy is protected from oxidation during its descent through the upper oxidizing zone of the cupola.

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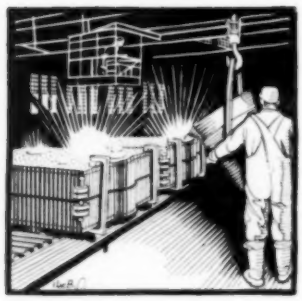


THE FOUNDRY for July

Don't Lapse INSURANCE

IN GOVERNMENT, industry and business the effectiveness of co-operative action has been established. No continued progress is possible without it. The foundry industry, fortunate in possessing strong technical, business and trade associations, is no exception. Under stress of unprecedented economic upsets, in the face of discouragement and misrepresentation on the part of competing industries; faced by oppression and possible disintegration, the foundry industry has maintained and advanced its position. Much credit is due its co-operative spirit, much to the leadership and initiative of well managed associations. Now, as never before, the foundry industry needs the best service of its organizations. No foundry should begrudge the full measure of loyalty, and freely should provide the reduced dues and fees under which many of these groups operate today. Hold fast, pay your dues and co-operate. If a non-member, affiliate. A splendid tribute to the drive which is bringing Britain again on the high road to reconstruction is the growth in membership of the Institute of British Foundrymen, Page 20, this issue. American foundrymen will do well to follow this example of the co-operative urge.

Steel Castings ON PARADE

ONE substantial service, attainable only through co-operative action is the ability to secure respectful attention from the public, consumers and engineers who specify cast products. The recent meeting of the American Society for Testing Materials, page 16, is a case in point. A symposium arranged jointly by the American Foundrymen's association and the A. S. T. M. brought together and presented a clear comprehensive and effective picture of the scope of steel castings service. Properties, uses, and fields of use were compiled, summarized and explained. This followed a similar symposium on malleable castings in 1931 and the same plan will be used in 1933 to show the progress and attainments in gray iron castings production. Truely an opportunity for the engineering world to learn the facts concerning cast products. Equally a splendid chance for the foundry industry to take stock of progress, to assemble and disseminate accurate data of great service. All this would be impossible, without co-operative effort.

Small Units GET BREAK

INEVITABLY, when orders are scarce, overhead mounts. This is a basic truth in cost practice. Large organizations suffer acutely. Large plant and equipment capital charges are piled upon high fixed charges and non-productive or supervisory wage and salary accounts. A frank expression from many owners of large establishments confirms a realization of this fact. The burden falls no less upon the departmental than upon the jobbing foundry. Often, a share of general administrative expense is distributed to add to the foundry overhead. Small jobbing units capable of assuming the work of such organizations have a definite opportunity. This statement is made without prejudice and in the interest of the best, most efficient and economical production of castings alone. The present disadvantage of the large production shop has a more direct significance in the support of a firm price policy when bidding upon work available under these conditions.

What's New IN JULY

WHAT it is and how it's made agitates every foundryman confronted with a demand for high test cast iron. R. S. MacPherran summarizes existing practice in two articles, the first in this issue (Page 12). Nearly fifty years in the foundry business, successfully producing nonferrous castings is the record of an Eastern shop. (Page 14). Awake to the opportunity and with full attention to new problems of economy and efficiency, equipment manufacturers prepare for reconstruction needs. (Page 60).

High Test Cast Iron

Practices followed in various foundries to secure exceptional physical properties

By R. S. MacPHERRAN

IT IS practically impossible in one article to list every phase of high test cast iron in the United States or to discuss all the various applications in the many companies using it. Therefore, instead of a general description covering to a limited extent all conditions this discussion gives a few specific and typical cases where this iron is being used successfully.

No standard quality for high test iron and no specifications covering recent developments are available. Various foundries adopt the material and practice best suited to their own needs. The subject is live with constant change and improvement. Any paper written at this time, January, 1932, may not contain all the latest developments in effect at the time it is presented.

In the past few years a marked tendency is noted toward specialization. One foundry will specialize in automotive heads and cylinders, a second in pistons or rings, a third perhaps in brake drums, etc. This specialization has been assisted by two factors. First—the great production demand of the automotive industry, and second—the development of the electric furnace. Of this latter it is estimated that over 80 have been installed in this country for the production of commercial iron castings.

What Is High Test Iron?

In discussing this subject a field must first be defined which covers high test cast iron as apart from the irons of lower strength. In this article, it was decided to include under this heading only those irons breaking above 45,000 pounds tensile strength per square inch, and that this test should have been made as far as possible on test specimen machined from the old standard American Society for Testing Materials arbitration test bars. These bars are cast 1¼ inches round in dry sand or cores and are broken transversely between 12-inch supports. Unless otherwise stated, tensile specimens were machined from the broken transverse bars in accordance with the type shown in Fig. 4.

In general high test iron is made in the foundry by one of the following processes:

A. Electric furnace (with or without duplexing from cupola)

B. Air furnace (with or without duplexing from cupola)

C. Cupola

The electric furnace, either melting with an initial cold charge or duplexing with the cupola melting, lends itself especially to the continuous production of small castings, usually automotive, and, therefore, does not always go into the field of highest strengths. This is for commercial reasons only, as this process can be adapted to any kind of iron desired. The details of this

Fig. 1—Micrographs of high test automotive iron made in the electric furnace and superheated. Upper—x100 and lower x2000 diameters

operation and the results are well shown in the recent papers on this subject read before the American Foundrymen's association and other organizations.

One installation using a 3-ton furnace specializes on automotive cylinders and heads. The regular operation is continuous. The iron is melted in a 48-inch cupola and tapped into the electric furnace, thus replacing at regular intervals the iron drawn off for pouring. When work is slack the electric furnace is used to melt from cold charges. A typical cold charge is 7700 pounds of cast iron borings, and 3000 pounds of cast-iron scrap, with 2800 pounds of baled, sheet steel. When duplexing through the cupola, scrap iron comprises the bulk of the charge with 20 to 30 per cent of bundled sheet steel added in the electric furnace. In this way the loss in melting bundled sheet steel scrap in the cupola is avoided and also the maximum reduction in carbon is obtained. The cost of material used in either method is always low. In 1930 the cost to this plant of iron in the ladle, when duplexing, was about 1.3c per pound. This includes all materials, power, interest, depreciation, and all labor including that of pouring. Of course, when alloy additions are made this cost is increased.

Recent tests of arbitration test bars made by this company to represent automotive work

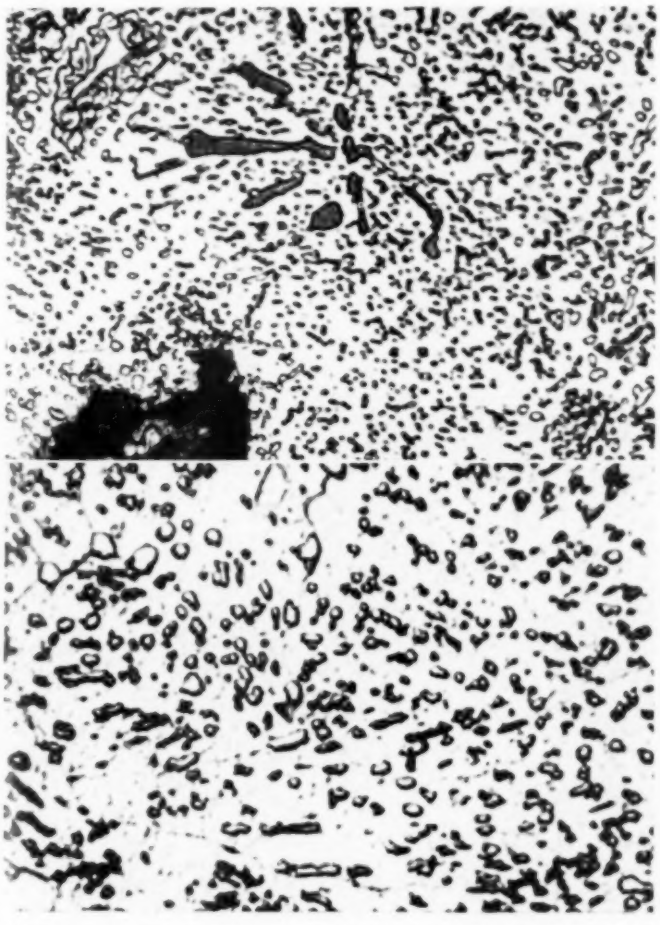


Fig. 2—Air furnace iron, heated and cooled in air. Note spherodization of cementite. Upper x1000 and lower x2000 diameters

Fig. 3—Air furnace iron, quenched and drawn, reheated and oil quenched showed slight surface decarburization. Magnified 2000 diameters

show the following physical properties:

Bar No.	Transverse load in lbs.	Deflection in inches	Tensile strength	Brinell hardness
1	5430	0.17	53,800	248
2	4850	0.15	48,400	241

The analyses of the bars gave:

	Bar No. 1	Bar No. 2
Total carbon	3.02	2.94
Silicon	2.36	2.41
Sulphur	0.086	0.079
Phosphorus	0.13	0.17
Manganese	0.82	0.85
Nickel	0.44	0.50
Chromium	0.37	0.31
Molybdenum	0.58	.....

Both a high impact value and an additional refinement of grain is claimed due to the superheating given. Fig. 1 shows this iron.

Brake drum production is shown as follows:

We take our cupola iron and put it into Detroit Electric furnaces, add sufficient steel to give us a white fracture and proper carbon content and graphitize in the ladle. Brinell specifications from 223 to 262. Tensile strength from 50,000 to 60,000 pounds, approximate analyses follows:

	Per Cent
Combined carbon	0.50-0.70
Graphitic carbon	1.80-2.00
Silicon	2.10-2.40
Manganese	0.30-0.50
Molybdenum	0.40-0.60
Phosphorus	0.20-Max.
Sulphur	0.09-Max.

We have had test bars pull as high as 80,000 pounds per square inch on this iron, but the average does not exceed 65,000.

A third company reports on the manufacture of cam shafts for automotive work as follows:

Electric furnace iron is used. The cam shafts are not heat treated, but are made with or without a chill as desired. With the arbitration test bars used (12 inches between supports), the following properties were observed: Transverse strength, 6000-7500 pounds; tensile strength, 55,000-60,000 pounds; impact, over twice that of ordinary cast iron; hardness, not chilled, 300 brinell; hardness, chilled, 600 brinell; torsion, equal to that of cam shaft steel; wear, remarkable wearing qualities. Cams running under conditions equivalent to 120,000 miles at 90-100 miles per hour show no appreciable wear.

Many air furnace installations using either cold stock or duplex (*Please turn to page* 50)

Nonferrous Castings Resist Corrosion

By NORMAN F. HINDLE

Fig. 1—The six pot type furnaces are fired with hard coal

FORTY-EIGHT years of continuous business activity in any industry is evidence of close adherence to sound business principles; cooperation with customers; study of their problems and aid in the solution of those problems. Production of a high grade product is essential to a long period of continuous existence.

This is the record of Thomas Paulson & Son Inc., Brooklyn, N. Y., for 20 years located at 97 Second avenue, but recently compelled to vacate its property due to condemnation proceedings necessitated by a public work. The firm now is located at 450-466 Union street engaged in the production of brass, bronze and aluminum castings and specializing in the production of bronze bearings.

The plant is divided into four main sections. The office extends across the front of the building and is followed by the molding department. At the rear of the molding department, is the furnace room and behind that the cleaning, finishing and shipping departments. Fig. 1 shows a view of the melting furnaces at the plant.

The melting department is equipped with six pot-type coal fired natural draft furnaces. Four use No. 70 crucibles (210 pounds) and the other two, Nos. 100 and 150 respectively (300 and 450 pounds). Two gas-fired furnaces supplement this equipment. A monorail extends into the molding department for the transportation of molten metal. Chain hoists are employed for lifting the pots from the furnaces. Following the general practice in eastern foundries, anthracite coal is used for fuel. Metal is melted in silicon carbide crucibles.

Lengthens Life of Flues

These furnaces in general conform to standardized design and construction. However, certain features incorporated in their construction are out of the ordinary. Heat resisting alloy steel flues and dampers have taken the place of cast iron. An extended series of experiments resulted in the adoption of the alloy steel. Cast iron flues formerly used grew under the repeated heating and cooling to which they were

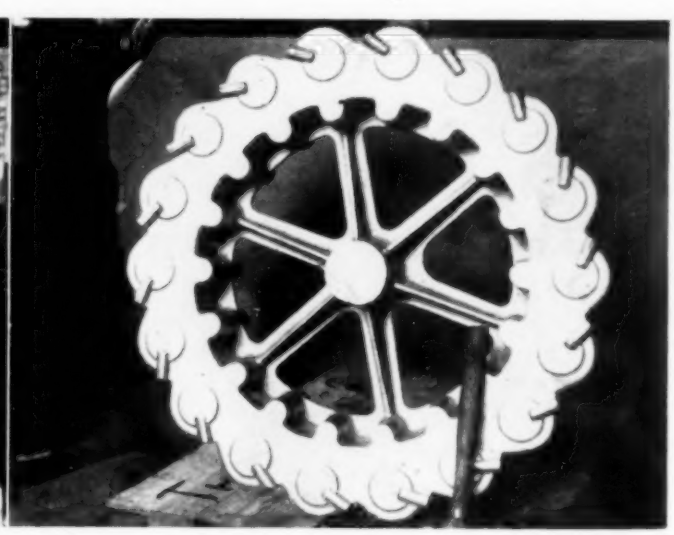


Fig. 2—A group of molds used in the manufacture of rubber dolls. Fig. 3—The size of the aluminum spider may be judged by comparing with the hammer handle at the left

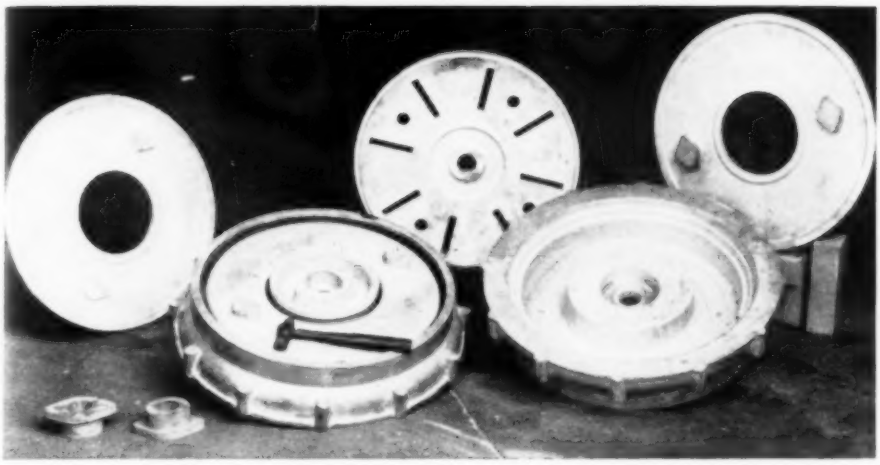


Fig. 4—A few of the many types of castings in nonferrous metals made by the Paulson foundry

subjected. Replacement of the flue involved destruction of the furnace lining and section of the stack. After 1½ years of nearly continuous operation the heat resisting alloy steel-flues show no signs of deterioration.

Various types of brick were used in an effort to find a suitable damper. Finally alloy steel dampers, similar in composition to the flue castings, were installed. Since these changes were made in flue and dampers the company has reduced repair and lining costs.

The molding department occupying the major part of the plant area is equipped for floor, bench and machine molding. Molding machines and benches are located close to the side walls while the center section is used for floor work. Number 00 Albany sand is used throughout the shop. Cores are made at one end of the molding room and are dried in ovens of several types to accommodate the variation in work which enters the shop. Ample light and ventilation are provided in the molding and core room and the white walls contribute to the light intensity.

Naturally over a 48 year period, the Paulson company has made castings in many nonferrous metals. Knowledge and experience acquired over that period were contributing factors in securing a recent contract for castings to be used in sewage treatment works equipment. Castings in these plants must be resistant to corrosion. An alloy containing 94.5 per cent copper, 4.5 per cent silicon and 1 per cent manganese was specified for that service after tests of several years duration proved its resistance to sewage corrosion.

That alloy developed by the American Brass Co., Waterbury, Conn., has the following physical properties in its cast form: Ultimate strength, 55,000 pounds per square inch; yield point, 25,000 pounds per square inch; elongation in 2 inches, 15 per cent; melting point, 1832 degrees Fahr.; and weight per cubic inch, 0.294 pounds in the cast condition.

After considerable experience in casting that metal the Paulson company has found that the physical properties are better than in the 88-10-2 alloy (88 copper, 10 tin, 2 zinc) and that the two alloys have practically the same machinability with metal shrinkage approximately the same as that of bronze. It is claimed that the metal is easy to handle, and the castings are cleaned without difficulty.

Metal is secured in ingot form and is melted in crucibles under a charcoal covering. No deoxidizer is used. The molten metal is poured at approximately 2100 degrees Fahr. as gaged by the eye. At regular intervals the efficiency of the eye is checked by pyrometer. Metal from two or more crucibles is poured into a ladle shown to the right in Fig. 1 when a large quantity of metal is required.

Most of the sewage treatment equipment castings are molded on the floor. Typical castings shown in Fig. 5 are molded two, three and four in a flask depending on the type. Some are molded singly. Two types of castings with the gates attached are shown in the foreground. The castings in the rear foreground were cast four in a mold. Metal was poured through one sprue at the end connected to gates leading to all four castings. A storage gate was used, as in gray iron practice, to catch (*Please turn to page* 59)

Fig. 5—Typical castings used in manufacture of sewage treatment equipment

Engineers Study Castings

Symposium on steel castings and gray iron specifications feature A. S. T. M. meeting

STEEL castings were passed in review for the benefit of engineers, designers and users at a joint session of the American Society for Testing Materials and the American Foundrymen's association during the thirty-fifth annual convention of the former organization in Atlantic City, June 21-24. The industry was represented through a general survey offered by W. C. Hamilton, American Steel Foundries, Chicago, chairman of the committee which arranged the symposium; statistics covering and analysing production and uses were presented by Granville P. Rogers, Steel Founders' Society of America, New York; and factors covering design, purchase requirements, physical and mechanical properties were followed by intimate and advance technical information all prepared by outstanding authorities in the specialties which they represented.

New Products to Replace Old

Zay Jeffries, consulting metallurgist, Cleveland, who presided at the second of two sessions held in the afternoon and evening, summarized in stating that the symposium served to show how the steel casting industry is helping to obsolete many things now in common use. He complimented the authors, on the judicial manner which marked the entire presentation—no author having appeared as an advocate for a commercial interest, but rather offering his data in the light of general informative value.

The speakers did not spare any shortcomings which they detected in the steel foundry industry. W. C. Hamilton, speaking at the opening session at which H. F. Moore, University of Illinois, Urbana, Ill., presided, deprecated that false pride which in the past impelled foundrymen to assume their ability to make all kinds of steel castings, regardless of their size and nature. This, fortunately for progress, has been succeeded by an endeavor to master a special product.

F. A. Lorenz, Jr., American Steel Foundries, Chicago, presented an able paper on design pointing to progress made since the time when all foundrymen mistook adverse effects of poor design for faulty foundry technique. In the past, too much effort was made to meet the customer's demand, leading to subterfuges such as chills and other measures often detrimental, which now are avoided through design which gives a better product, more economically produced and capable of greater ultimate service. He detailed those properties of contraction, mass effect, crystalization phenomena and heat transmission which must be understood by the engineer before he properly may design steel castings. Classic examples of faults and also favorable factors were presented.

Too Many Specifications

R. A. Bull, Electric Steel Founders' Research group, Chicago, in his paper on purchase requirements stated that despite the wide diversity of society, governmental and private firm specifications which exists, no conclusion regarding rejection limits to apply to any well known foundry steels have been developed, with the single exception of Hadfield's manganese steel. Foundries give guarantees not to be found in any ap-approved specifications and requirements as to chemical, physical properties and heat treatments vary with individual contracts in many instances. The fallibility of attached test coupons was shown to be due to conditions of casting, variations in section from typical casting

Castings Symposiums Examples of Co-Operative Work

PRESIDENT F. O. CLEMENTS, General Motors Corp., Detroit, in addressing the opening session of the American Society for Testing Materials, which met in Atlantic City, June 20 to 24, complimented the organization on being able to carry on its activities practically without impairment under trying economic conditions. While a slight loss in membership was reported by C. L. Warwick, secretary-treasurer, the society has functioned practically without abridging any of its activities and with a favorable financial showing. The successful exhibit of testing instruments and equipment held in 1931 will be repeated in 1933 at Chicago. Meantime much co-operative work is being performed with other societies. An example of this is the symposium on steel castings held this year with the American Foundrymen's association. Following a similar presentation of malleable last year and one on gray iron projected for 1933.

Cloyd M. Chapman, Consulting Engineer, New York, President-Elect, A.S.T.M.

W. H. Bassett, Metallurgical Manager, American Brass Co., Waterbury, Conn., New Vice President, A.S.T.M.

sections and many other discrepancies. A complete summary of specifications showed the wide range of choice exercised. The error of gaging the influence of any single element, excepting in relation to proportions of other elements was stressed.

Buying on Ideas Alone

The inter-relation of the papers on design and purchase requirements induced overlapping discussion. P. E. McKinney, Bethlehem Steel Co., Bethlehem, Pa., stated that buyers often expect a foundryman to give a price on an idea, or a rough drawing and when the finished drawing or pattern finally is available, many nonessentials adding to cost and complicating production are encountered. Closer co-operation is the solution proposed. John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J., steel foundry adviser to THE FOUNDRY, stated that there is a disposition to rely less on the physical properties of the test coupon and expect rather to trepan a test specimen from the casting.

F. A. Lorenz, Jr. stated that present day practical production problems should be considered by buyers. With small orders on 20 to 30 different specifications confronting a foundry working on reduced scale, close adherence to chemical variations is impossible, although the foundryman can give the customer what he needs, if permitted to meet physical requirements.

An extensive paper on physical and mechanical properties of cast steel, by C. H. Lorig and C. E. Williams, Battelle Memorial institute, Columbus, O., closed the afternoon session. The range from 0.25 to 0.35 per cent carbon was offered as the normal range of plain carbon steel castings with high and low carbon covering the territory above and below this division. The carbon steels gain in strength and lose in ductility with the addition of carbon and perform in inverse ratio with lowering this element. The variation of carbon cast steels under addition of other constituents and under heat treatment is equal to wrought steel of similar character. Nickel adds ductility at low temperature and the embrittling effect of nickel is decreased in higher temperatures by heat treatment. Addition of copper above 0.5 per cent has been found to improve mechanical and elastic properties. Silicon adds ductility to low carbon steel while embrittlement at high temperatures is decreased with added silicon content. Molybdenum in cast steel increases yield point to a marked degree at elevated temperatures. Vanadium gives highly elastic, shock and wear resistant properties.

Useful Pearlitic Steels

FRED GROTTS, Continental Roll & Steel Foundry Co., East Chicago, Ind., prepared the paper which opened the evening session, and which was presented by Mr. McKinney. The various properties of cast medium pearlitic steels were covered in detail, from data contributed by foundries making these products commercially. These new types of steel range from 0.30 to 0.40 per cent carbon and with additions of from 0.50 to 3.0 per cent manganese with various alloys and have been designed to give from 75,000 to 130,000 pounds tensile strength and various properties for special services.

Corrosion resistant steels were surveyed by Jerome Strauss, Vanadium Corp. of America, Bridgeville, Pa., who defined this class as essentially alloys of iron and chromium to which different other elements are added to impart properties demanded by special applications. They are finding useful service where exposed to polluted atmosphere, sea water, chemicals, molten salts and metals at both atmospheric and elevated temperatures. Failures may result from either chemical or mechanical causes, due to wrong chemical constituents, faults of design, temperature, abuse in heating and cooling, fatigue, changes in structure due to continued exposure, or defects of (*Please turn to page* 56)

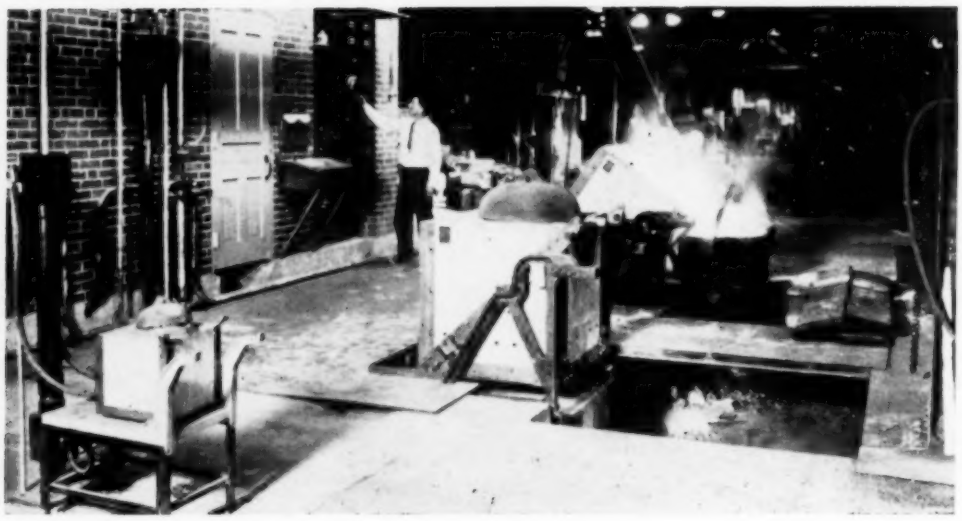


Fig. 1—Three furnaces at the Lebanon Steel Foundry secure power from a 300 kilowatt generator

Coreless Induction Furnaces

Melt alloy steels, plain carbon steels, gray iron and bronze for cast products

By R. N. BLAKESLEE JR.

DURING the last 3 or 4 years, a number of interesting installations of coreless induction furnaces have been made in foundries. These furnaces sometimes are called high frequency furnaces because usually, but not always, they are powered with current whose frequency is over 60 cycles.

The furnaces have proven valuable because they reproduce analysis and structure of alloys and reclaim scrap, particularly chromium bearing scrap, with low loss. Flexibility permits considerable tonnage per day in relatively small weight heats. In general, the field of this furnace has been limited to the melting of alloy steels such as stainless, heat and corrosion resisting; high speed steel; plain carbon steel; also cast iron and bronze.

Melts Steel in Three Furnaces

An installation at the Lebanon Steel Foundry, Lebanon, Pa., shown in Fig. 1, consists of a 300 kilowatt generator, driven by a unity power factor synchronous motor, and three furnaces. The generator produces the 960 cycle power with which the furnaces are energized.

Two larger furnaces are rated 1000 pounds each and are so arranged that either one may be put in service or, if preferred, a heat can be melted in one furnace while the other one is being charged and vice versa. The small furnace is rated at 50 pounds capacity and is used to make pilot heats or small castings. It is so connected that it may be run simultaneously with one of the large furnaces.

Either acid or basic linings are used. Often one furnace is lined basic and the other acid.

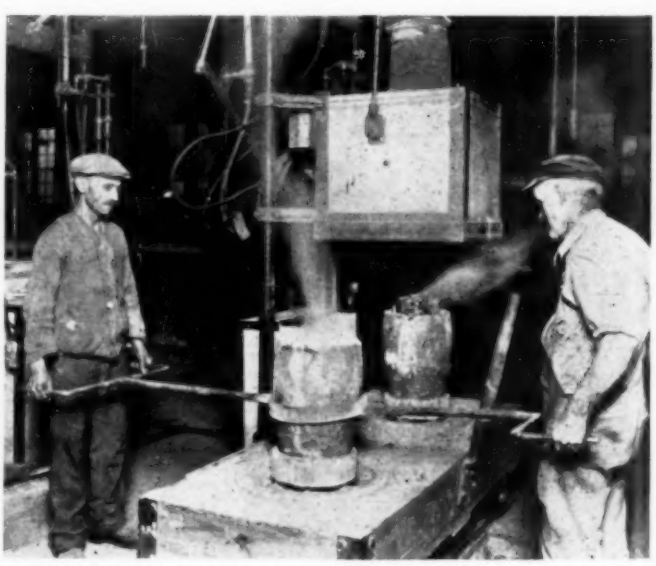


Fig. 2—One hundred kilowatt lift coil furnaces at the General Fire Extinguisher Co.

The basic linings are more costly but, in general, give longer life. Figs. 4 and 5 show some of the work produced in the furnaces. Fig. 5 is a centrifugal pump casting for handling corrosive liquids. This casting is made of a 30 per cent chromium, 12 per cent nickel stainless steel. Fig. 4 shows filter press frames and plates made from a low carbon 18 per cent chromium, 8 per cent nickel stainless steel.

All three furnaces usually are tapped into ladles and molds poured off from the ladles. A regular shop crane is pressed into service to tilt the furnaces, which swing around the spout. With 300 kilowatt capacity, the melting time of a 1000 pound charge of 18-8 is about 1 to 1¼ hours with the time for the complete cycle depending on whether one large ladle or a number of small ladles are used. In the latter case, a small amount of power is kept on the furnace to maintain temperature

Use Lift Coil Type Furnaces

The three induction type furnaces are arranged with flexible lead connections which permit power being kept on the furnace even when tilted until practically all the metal is poured. The 50 pound furnace draws 30 to 60 kilowatts, depending on whether or not there is a large furnace on at the time, and heats take from 20 minutes to 60 minutes to melt.

Furnaces used to melt bronze are installed at the General Fire Extinguisher Co., Providence, R. I. Power supply is a 100 kilowatt, 480 cycle generator, induction motor driven. The motor generator set is located in the basement of the building while all meters and controls are located at the furnace in the foundry on the third floor.

The furnace, which is known as the lift coil type, and is shown in Fig. 2, consists of the usual water cooled inductor mounted in a box which can be raised vertically on guides by a hoist. The No. 70 standard crucibles are mounted on a truck, which runs on a track. When the truck is pushed against a stop on one end of the track,

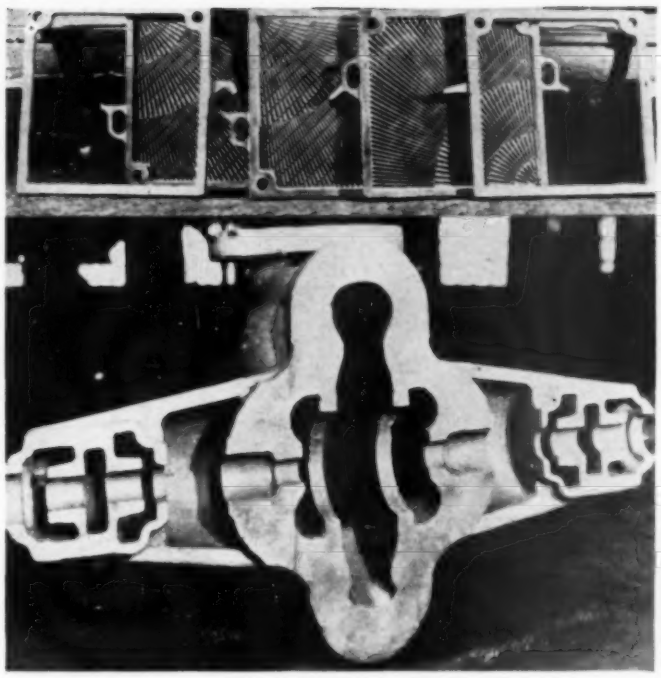


Fig. 4 (Above)—Filter press frames and plates. Fig. 5 (Below)—Centrifugal pump casting

one crucible lines up with the inductor coil box and the box is lowered over it.

Power is then turned on and melting starts. While the melting is progressing, the second crucible is charged with scrap or ingot. The melting of an 89 per cent copper bronze requires 16 to 18 minutes, depending on whether the crucible was originally hot or cold. When the charge is melted, the box containing the inductor coil is raised quickly. The truck is then pushed against the stop on the other end of the track. This lines up the second crucible containing the new charge with the coil and the box and coil are lowered over it, power is applied and the metal in the second crucible starts to melt.

In the meantime, tongs are slipped over the first crucible filled with molten bronze and it is carried to the molds (*Please turn to Page* 46)

Fig. 3—General view of the installation of high frequency furnaces at the foundry of Babcock & Wilcox Co.

Institute of British Foundrymen

Stresses work on heat treatment of cast iron at annual convention held from June 7 to 10

By VINCENT DELPORT

NEWCASTLE-UPON-TYNE was the seat of the twenty-ninth annual meeting of the Institute of British Foundrymen, June 7 to 10. Notwithstanding the depression, which has hit principal industries of the Newcastle district severely, a complete program was arranged, and about 250 members from all parts of Great Britain helped to make the meeting a success. The conference was opened June 8 with A. Harley, Daimler Co., Ltd., Coventry, and president of the institute, presiding. A civic welcome was extended the visitors by the Lord Mayor of Newcastle, and others.

The president announced the Oliver Stubbs medal had been awarded to J. E. Hurst for important work on heat treatment of cast iron. The medal was presented to Mr. Hurst by the Lord Mayor. In the report of the general council it was stated that the membership roll on April 30 showed a total of 1919 members, compared with 1844 on April 30, 1931. Election by the general council of F. J. Cook and John Shaw as honorary life members was announced, this honor having been conferred as a recognition of their services to the institute over a period of many years. The first report of the technical committee was then presented.

Award Diplomas for Best Papers

Awards of diplomas for the five best papers of the year were announced, together with the recipient of the Buchanan medal, awarded to a member of the Lancashire branch. Among the five diplomas, one was conferred upon Guido Vanzetti for his paper on the steel foundry industry in Italy, which he had presented personally during March before the London and Lancashire branches.

Victor Stobie, of the Stobie Steel Co., Ltd., Dunston-on-Tyne, was elected president for the year 1932-33 and was duly inducted to the chair by Mr. Harley. C. E. Williams, John Williams & Sons (Cardiff), Ltd., was elected senior vice president, and Roy W. Stubbs, Joseph Stubbs, Ltd., Manchester, junior vice president. A. Harley was elected as a trustee to take the place of the late Oliver Stubbs. Five members were elected to the general council.

Victor Stobie in his presidential address, stressed the wide field open to ironfounders through a more exhaustive scientific investigation of the metal. The foundryman should direct his attention to the study of physics, perhaps more than to that of chemistry. Mr. Stobie mentioned that as far back as 1885, Professor Turner had shown the fruitful results of physical investigation. The speaker emphasized the vast amount of research that has been effected in the domain of all other metals, and that now cast iron also is being studied thoroughly.

Offers Guide to Molding Methods

The first paper was the French exchange paper, by J. Pillon, professor at the High School of Foundry, Paris, entitled "Introduction to the Study of Molding and Casting." The object of the paper is to guide the molder in investigating methods of molding, and to choose among those available that which will satisfy in the best possible way conditions imposed by what may be called the *parameters* of molding. Apart from metallurgy, the following parameters can be cited for molding: Selling price; size of the castings; importance of the order from the point of view of quantity; maximum simplicity in molding; tolerances imposed; delivery period imposed; soundness of the metal and ease of machining; skill of the operatives; materials.

The next paper, "Quantity Production of Gray Iron Castings," by J. O'Sullivan, Ford foundry, Cork, Ireland, describes principles governing operation of that foundry. These principles are derived from those applied at River Rouge. In the discussion J. W. Gardom referred to a statement that he had heard, that the Ford foundry at Cork obtains 20 per cent more from its molding machines than any other foundry. That, said the speaker, is due largely to thorough and efficient organization.

V. C. Faulkner, *Foundry Trade Journal*, London, pointed out that even there, men still are seen testing the moisture of the sand with their hand. It was stated in reply that this was still

the best method as yet found. A speaker later suggested the use of a water-meter. Replying to a question by F. J. Cook, who referred to the low phosphorus content adopted by the Cork foundry in their cast-iron analysis, Mr. O'Sullivan said that the percentage ranged from 0.17 to 0.22, depending on the job. This low phosphorus content has not caused any particular trouble. A. Harley inquired whether tests had been made with regard to wear. Mr. O'Sullivan replied that they had found low phosphorus beneficial for castings presenting various thicknesses. For wear, the brinnel specification is 180 to 200, and is often exceeded. W. Scott, Armstrong-Whitworth's, suggested that by lowering the carbon content there would be more latitude with regard to variations of other constituents, particularly silicon.

Ferrous and Nonferrous Metals

Papers were presented Thursday morning, June 9, at two sessions. Dr. W. Rosenhain contributed a paper entitled "Ferrous and Nonferrous Metals in the Foundry." The underlying thought is that it should be possible to break down, at least partially, the line of demarkation that has grown up between ferrous and nonferrous metallurgy. This applies to practice, methods, and other research work.

Suggests Bottom Pouring Ladles

V. C. Faulkner stated that if metal is cast at too high a temperature, there are surface blowholes. He mentioned that in the south of England the residual heat of electric furnaces used for melting steel is taken advantage of to melt malleable iron. He also said that it is surprising that bottom pouring ladles are not used in iron foundry practice. Dr. Rosenhain, in replying, said the difficulties relative to bottom pouring could be remedied, and that this method of pouring should be recommended.

The American exchange paper, "High-Test Cast Iron in the United States of America," was prepared by R. S. MacPherran, Allis-Chalmers Mfg. Co., Milwaukee, and presented in abstract by V. Delport, European manager THE FOUNDRY. The first section of (*Please turn to page* 49)

Victor Stobie Made President of I. B. F.

VICTOR STOBIE, Stobie Steel Co. Ltd., the new president of the Institute of British Foundrymen, has been a member of that organization since 1912 and during 1927 and 1928 was president of the Newcastle branch. Mr. Stobie is a native of Birmingham, Eng., and received his education at St. Maur's school, Paris. Later he studied electrical engineering at University college, Sheffield, and then entered the metallurgical department of the same institution under the tutorship of professors Arnolds and McWilliam. Later he established the Sheffield Annealing Works, Sheffield.

Mr. Stobie established the Stobie Steel Co. Ltd., Sheffield, in 1909. He sold his Sheffield interests in 1912 and established an electric steelworks on the Tyne at Dunston.

He is governor of the Sures Memorial which holds examinations on foundry technique at Newcastle and Glasgow in alternate years and makes awards. He has presented papers on various technical subjects at meetings of the Iron and Steel institute, Institute of British Foundrymen and other societies and technical groups.

ROY W. STUBBS, elected junior vice president of the Institute of British Foundrymen for 1932-33 was educated at Victoria Park school, Manchester, and at the Manchester grammar school. In January, 1913, he entered the firm of Joseph Stubbs, Ltd., of Ancoats and Openshaw, Manchester, machine makers and ironfounders. He served in the core department, the molding shops, and throughout the foundry generally. During that period he attended the College of Technology of Manchester for the courses of metallurgy, machine drawing and patternmaking.

He served in the war, after which he returned to the foundry in an executive capacity, in 1920, and later joined the board of directors. Upon the death of his uncle, the late Oliver Stubbs, he was placed in charge of the foundry.

Mr. Stubbs served his apprenticeship under the able guidance of his uncle. He is now a member of the executive board of the National Ironfounding Employers' federation, a member of the executive committee of the Manchester Ironfounders' association, and a member of the Manchester Association of Engineers.

Refining Methods for Gray Iron

Bullard Co. Utilizes cupola forehearth and fused soda ash in regular practice

By B. F. MILLER

HARMFUL effect of sulphur in cast iron when present in excessive quantities generally is recognized, and has resulted in an increasing tendency to limit sulphur contents in specifications covering important castings. Control of that impurity in cast iron is an important problem in foundry practice.

Use of a large percentage of scrap or of pig iron or coke with a high sulphur content may be the cause of high sulphur in cast iron. An abnormal sulphur pick-up, such as often occurs when melting to the cold side also may be a contributing factor. In each case other occluded impurities, both gaseous and solid, generally, if not always, are present. An increase in scrap in a mixture ordinarily results in reducing machinability of the metal. This result is caused more by the dulling effect of occluded oxide-silicates on the tools than by any actual hardness of metal resulting from action of high sulphur on an increased iron carbide content.

Machinability Is Improved

By removing entrained oxide-silicate particles the refining closes up the structure of the metal. This change in structure increases the brinell number and machinability is improved because the tools are not subject to the dulling effect of the oxide-silicates.

Refining gray iron from the cupola with alkaline slags is not new in itself but the practice has been improved by developments in desulphurizing methods. These include development of an improved form of soda ash, improvements in types of equipment and better methods of handling the slags.

A study of the results at the foundry of the Bullard Co., Bridgeport, Conn., illustrates features of refining metal with alkaline slags. High quality of its products requires the finest type of gray iron castings and lends to the foundry practice an interest shared by all foundries whose standards are equally high.

That company's experience in reducing sulphur content of castings by 30 per cent with a reduction in direct cost per ton of metal of from 4.5 to 8.9 per cent probably will benefit others. This further improvement in the castings, already high in quality, was accomplished by improvements in melting practice, installation of a forehearth and refining the metal from the cupola with fused soda ash.

Make Changes on Two Cupolas

The change first was made on the 60-inch cupola in 1927 and later was extended to the 42-inch cupola. The new practice has been followed continuously since that time. Although the total savings at that time, amounted to $5500 per year, savings at this time are relatively of more importance, owing to the present low prices of good machinery scrap in relation to current pig iron prices. With the same output today the savings would run $8125 per year.

The following describes the three cupolas

Fig. 1—Cupola forehearth shown in operation at the plant of the Bullard Co.

used in melting iron for the gray iron castings:

Size Inside Lining Inches	Capacity Tons Per Hour	Fore-Hearth	Forehearth Dimensions Inches		Working Capacity
60	15-16	Since 1927	Inside lining Slag hole	32 37	4 tons
28	1.5	None	—	—	—
42	7	Since 1930	Inside lining Slag hole	26 30	2-tons

The 60 and 42-inch units are used in production and the 28-inch cupola is employed for experimental purposes. Operating practice with the 42-inch cupola follows that of the 60-inch cupola so the former is not treated separately. When melting in the 28-inch cupola the metal is refined where required with additions of the flux to the mixing ladle. However, that practice is used only on relatively heavy castings where the metal may be held for 10 to 15 minutes for thorough skimming before pouring.

Metal Alloyed in Ladle

While other types of castings are handled by the foundry, gray iron castings to which this discussion is limited, range in size and weight as follows: Size from bench to heavy machinery castings measuring 10 x 8 x 6 feet; sections from 3/16 to 10 inches; weight from ¼-pound to 12 tons; and tensile strength from 30,000 to 65,000 pounds per square inch. Metal for high-test castings is alloyed in the ladle.

Previous to installation of the forehearth at the 60-inch cupola, metal was tapped directly to the pouring ladles or occasionally to a mixing ladle. One pig of fused soda ash per ton of metal was used in the cupola then as now to add fluidity to the slag. The following gives the operating data for that period:

Cupola Charge
Pig Iron .....50 per cent
Foreign scrap and returns.....50 per cent
Coke.....267 pounds per ton
Limestone .....60 pounds per ton
Fused soda ash.....2 pounds per ton
Melting temperature over 2700 degrees Fahr.

	Average Analysis of Castings		
	Sections/ to 1 inch Per Cent	Sections/ 1 to 2 inches Per Cent	Sections/ 2 to 10 inches Per Cent
Silicon	1.8-2.0	1.5-1.8	
Manganese	0.8-1.0	0.8-1.0	0.8-1.0
Phosphorus (maximum)	0.23	0.23	0.23
Sulphur	0.09-0.11	0.09-0.11	0.09-0.11

In sections 2 to 10 inches, the silicon is reduced according to the size of the section.

After installation of the forehearth in 1927, cupola operation was unchanged, except for the mixture. In starting the heat the metal is allowed to accumulate in the cupola until it reaches the level of the slag hole as before, after which the tap hole is opened and metal continues to flow direct from the cupola into the forehearth throughout the balance of the heat. Forehearth is heated thoroughly with an oil-burner before making the first tap, which generally is sufficient to fill the forehearth about half full.

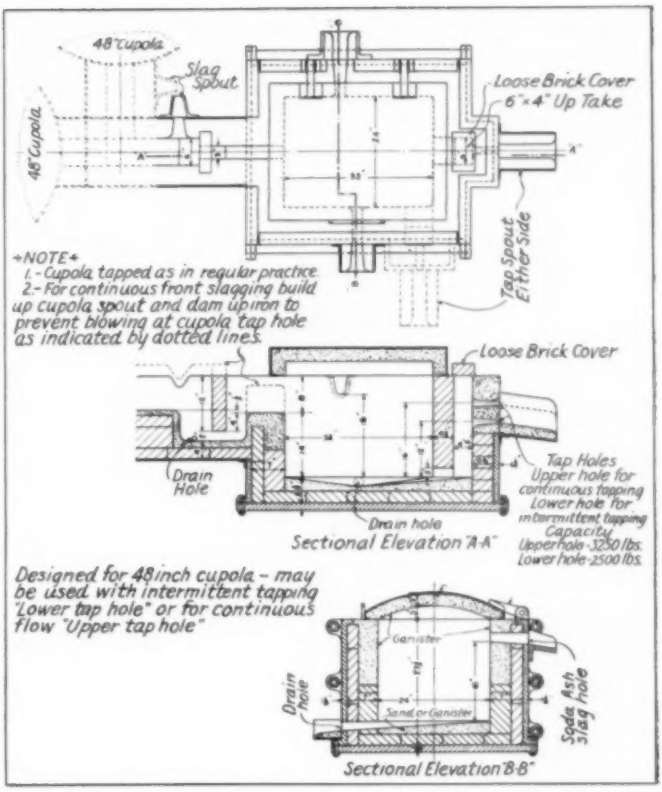

48" Cupola
Slag Spout
Loose Brick Cover
6" x 4" Up Take
48" Cupola
Tap Spout Either Side
NOTE
1.- Cupola tapped as in regular practice.
2.- For continuous front slagging build up cupola spout and dam up iron to prevent blowing at cupola tap hole as indicated by dotted lines.
Loose Brick Cover
Drain Hole
Tap Holes
Upper hole for continuous tapping
Lower hole for intermittent tapping
Capacity
Upper hole-3250 lbs.
Lower hole-2500 lbs.
Drain hole
Sectional Elevation "A-A"
Designed for 48 inch cupola - may be used with intermittent tapping "Lower tap hole" or for continuous flow "Upper tap hole"
Canister
Drain hole
Sand or Cinder
Soda Ash Slag Hole
Sectional Elevation "B-B"

Fig. 2—Diagram showing construction of the forehearth designed for the 48-inch cupola

Two pigs of fused soda ash, 4 to 5 pounds, are used regularly per ton of metal. These are added on the stream of iron in the cupola spout and flow into the forehearth. Addition of the flux is timed roughly in proportion to the rate of flow of iron from the cupola. With the first tap, several tons pass into the forehearth rapidly and larger quantities of flux are added at that time, which builds up a bath of slag and gives continuous refining of metal. Later, after the head of iron is out of the cupola, additions are made at regular intervals. Operating data for 60-inch cupola with forehearth follows:

Cupola Charge
Pig Iron .....35-40 per cent
Foreign scrap and returns.....65-60 per cent
Limestone .....60 pounds per ton
Coke .....267 pounds per ton
Fused soda ash in cupola.....2 pounds per ton
Fused soda ash in forehearth....4-5 punds per ton

Analysis of the castings remained the same as that indicated previously, with the exception that sulphur was reduced to 0.06 to 0.07 per cent.

Temperature of metal from the forehearth showed about the same as that formerly obtained at the cupola spout, namely over 2700 degrees Fahr., despite the general belief that the use of a forehearth tends to cool the metal. With continuous flow of iron and slag from the cupola, bed coke, formerly covered over with slag and iron, is open for combustion, resulting in superheating the iron in the cupola and off-setting any temperature loss in the forehearth. Furthermore, action of fused soda ash in these quantities helps the *(Please turn to page 48)*

Steel Founding in America

Castings have appearance and cleaning quality equal to highest standard of other countries

By F. A. MELMOTH

NATURALLY bonded sands are available in America, and are of stated good quality, but the great bulk of the molding sand used in steel foundries is synthetic; that is, it is composed of a base of highly pure silica sand, to which is added the necessary bonding material.

American mentality always leans toward standardization, and in sand preparation for castings this inclination is prominent. Instruments have been devised and are in constant use to test all sands for permeabiity and bond strength.

Care in selection of base silica sand, and required binder, with consistent checking of each consignment, together with testing methods, insures sand to molders within practical limits of constancy in those factors controlling satisfactory production of steel castings.

Foundry Sand Is Renovated

Almost all steel foundries employ some method of renovation. Both screening and pneumatic removal of fines are used widely. It is realized that only thus can consistent behavior be expected from molding sand. As a consequence, large proportions of used sand appear in the facing sand mixtures, and economy in facing sand cost thus is secured.

So far as the author is aware, there is no equivalent of the European *Compo* in use in American steel foundries. Sand mixtures are varied to suit varying sizes of castings, but even for large castings it has been found unnecessary to resort to composition molds.

Viewed from the standpoint of obtained results, the author would say that steel castings in American foundries he has visited possess an appearance and easy cleaning quality well up to the highest standard exhibited by other countries. Requirements of surface finish are just as strict as those existing elsewhere, and the industry as a whole is meeting those requirements.

The answer to the whole question is found in an insistence on regularity; regularity of original sand; regularity in its preparation; and regularity in the making molds. To that end, all efforts are bent continuously, and research to improve that factor of regularity is being carried out consistently.

At one time, the cleaning room was in the nature of a bottle neck in most steel foundries. It now is realized fully that the ultimate result of any production scheme in the foundry itself is nullified entirely by inefficient cleaning room arrangements, and close attention has been given to ensuring equal speeds of cleaning to casting production.

Efficiency in that respect depends upon two main points. Cleaning being a purely mechanical series of operations, mechanical efficiency in the plant used is a prime essential. Modern equipment therefore is all designed with a view to decreased handling.

However, a factor of at least equal effect has been in operation outside the volition of the cleaning room itself. Next to performance in service, or characteristics revealed by machining operations, the steel foundry's own cleaning room is the index to efficiency of the foundry.

It has been said that the cleaning room

Fig. 5—The electric furnace enables many varied analysis of steel to be produced in small quantities

possesses no problem of its own; they are all inherited. Sand and metal control, improved methods of heading and gating in the foundry by producing castings easier and cheaper to clean, have dealt largely with problems at one time associated with cleaning steel castings.

It also has become common practice to consider economics of the cleaning room when planning methods of gating and feeding. A mental viewpoint which, includes the cleaning room, developed in the minds of foundry operatives responsible for casting methods, can do more to reduce cleaning room costs than any other single factor.

Almost all steel castings made in this country are subjected to some form of heat treatment. Engineering development, which calls for increasing performance capabilities, has rendered this an almost universal necessity. It is realized that in the *as cast* condition a large part of the potentialities of performance of a steel casting remains locked up and unavailable in service, able only to be freed by adequate structural modification through heat treatment.

Use Every Form of Heat Treatment

For specific purposes, every modification covered by the term heat treatment is in use regularly, ranging from straight annealing, through normalizing, or normalizing followed by a draw, to liquid quenching and the necessary draw. Efficient treatment demands good equipment, and American steel foundries as a whole possess furnaces of very satisfactory type. Designed for even heat distribution, and efficiently insulated, they commonly are both efficient and economical in use. Automatic temperature control is popular, and is indeed almost a necessity.

Related to heat treatment, is the question of demanded specifications.

A perusal of the more common ones indicates that for equivalent purposes American specifications are no less severe than those operating in other countries.

Dealing specifically with steel castings, it is noteworthy that there is a greater insistence on yield point and reduction of area in American specifications. This is significant, in that it is the common belief that these two factors are of great importance, and are real indications of quality in the product. It is certain that their relation to heat treatment is significant, as in mild steel castings no other factor so quickly indicates either the absence of treatment or its unsatisfactory performance.

Few foundries limit production to plain carbon steel castings. All the commonly accepted alloy steel compositions are available in casting form, and indications are favorable to an increase in their use. Knowledge of the behavior of alloy steels in casting form is not too plentiful but is continuously being accumulated.

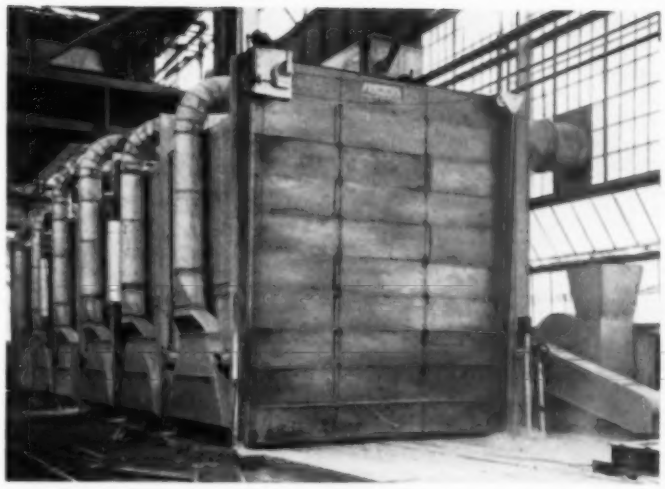


Fig. 6—Due to development of equipment, the cleaning room has ceased to be a bottle neck in the foundry

The ideal method of fitting the steel to the job is developing, and the wide range of varying compositions, each possessing individual characteristics, gives the designer a great field of choice. It is now fully realized that performance value of an alloy steel is not indicated by composition data alone, but that each type calls for suitable heat treatment.

Engineering development in the United States is rapid indeed, and the steel founder, if he is to keep his place as a supplier of materials, has to face the fact that materials of special capability continuously must be forthcoming. High speeds, high pressures, and high temperatures, and lightness in moving parts are the order of the day. That these demands are being met continuously and in the main satisfactorily, indicates a healthy condition of growth of special steel knowledge on the part of steel foundrymen.

Alloy Steels Constantly Increasing

At the present time there is a plethora of types of alloy steel available for use in steel castings, and their number is increasing constantly. Physical characteristics in many cases duplicate one another, and often the use of a certain steel for a particular purpose is controlled by either the desire of the purchaser or the individual opinion of the manufacturing foundry.

The following list gives some little idea of the many types most commonly in use:

Structural and General Engineering Purposes: 1. Carbon-Molybdenum; 2. Carbon-Vanadium; 3. Nickel; 4. Nickel-Manganese; 5. Manganese-Molybdenum; 6. Nickel-Chrome—with varying nickel content up to 3½ per cent; 7. Nickel-Vanadium; 8. Chrome-Vanadium.

Combined High Temperatures and Pressure: 1. Nickel-Chrome; 2. Nickel-Chrome-Molybdenum.

Resistance to Abrasion: 1. Manganese steel; 2. High Carbon Nickel- (*Please turn to page* 53)

Recover Dust in Sand Spun Plant

Apprehension, collection and disposal of dust problem solved by American Cast Iron Pipe Co.

By S. D. MOXLEY

IN THE manufacture of cast iron pipes by the centrifugal sand spun method, one of the most important features is the selection, separation and control of sand for the refractory mold. No less important from the standpoint of cleanliness of plant and surrounding community is the apprehension, collection and disposal of dust arising from various operations.

The refractory mold lining is silica sand with a relatively large amount of clay-wash (yellow field clay) added for strength. The mold is faced with pulverized coke in a wash as in ordinary pipe foundry practice. The condition and characteristics of the sand must be suitable to withstand molten iron at considerable pressure and to allow for rapid escape of gas and steam during the casting operation. To maintain these qualities the fine particles of sand, burned clay and blacking must be removed constantly in varying amounts to meet the various molding requirements.

Ratio of sand to iron cast is approximately 1½ to 1 with a shakeout temperature of 600 degrees Fahr. Sand is retempered and used every 6 to 8 hours. This severe service creates large amounts of extreme fines, and the flakey nature of the clay particles makes collection and handling difficult.

Remove Fines from Sand

Practically all sand handling and conditioning machinery is equipped with hoods connected by air ducts to the dust collectors. A suction velocity of 300 to 500 feet per minute in all hood openings is maintained to prevent dust escaping. At several points in the system a current of air is passed through the stream of hot sand to remove the fines and impalpable particles.

After a thorough study of the problem and equipment available it was decided to use bag type cloth screen filters to effect the removal and collection of fines. Two 16 compartments units were installed, as shown in the accompanying illustrations, each handling approximately 20,000 cubic feet per minute. These units were connected in series with sand traps to the trunk lines leading from the plant. The heavier par-

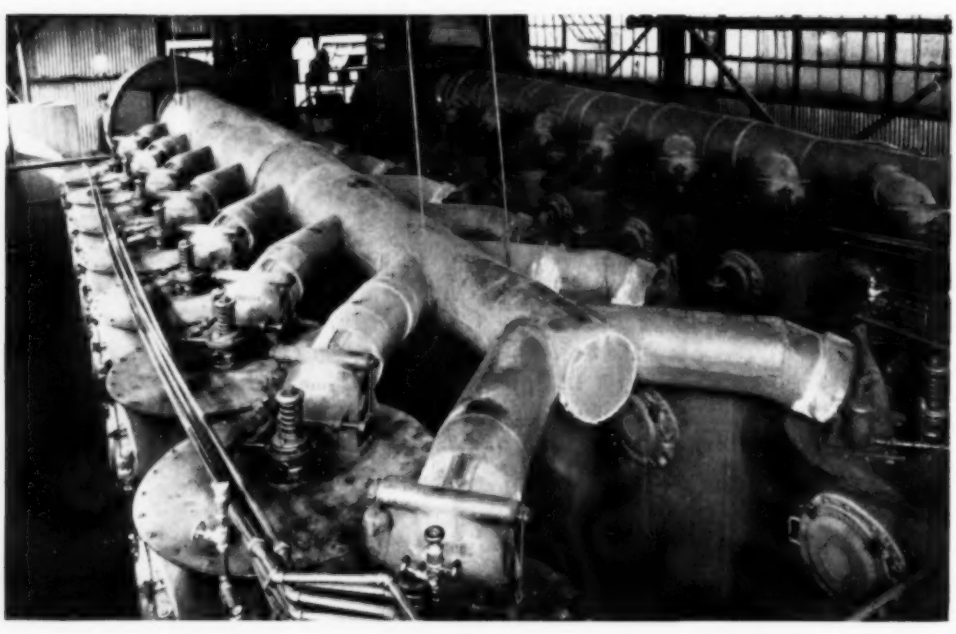


Fig. 1—View showing outlet manifolds and fans of the two 16 compartment filter units. The equipment uses a bag type cloth screen filter

ticles settle in the sand trap and balloon intake manifold, are collected and conveyed in screw type conveyors to the discharge spout. Dust laden air passes from the intake manifolds into the filter compartments where dust is collected on the inside walls of the bags and the cleaned air is drawn through and out the exhaust manifold to the fan and thence to the atmosphere.

Each compartment is equipped with an automatic shaking device, adjustable for frequency and duration of shaking periods. During the shaking period the direction of air is reversed. The dust removed from the bags is precipitated in the filter hoppers and discharged into the screw conveyor below. As only one of the 16 compartments of each unit is shaken at a time, the fluctuation of the static suction of the total unit is a minimum.

Much trouble was experienced in disposing of the collected dust, due to the nature of the material and distance to be conveyed. Tank wagons were used first to prevent escape of dust into the atmosphere en route. This method was found impracticable. The dust packed to such an extent that it had to be dug out at the unloading point.

Agitate Water Mechanically

A mechanically agitated water tank to receive the collected dust from the screw conveyors was installed and found entirely satisfactory. The tank has sufficient water capacity to receive eight hours run of dust (2000 to 3000 pounds per hour) and hold it in suspension. The dust is discharged into the agitated water through flared submerged spouts which form air seals for the screw conveyors. After each 8-hour working period, the water and dust sludge is delivered to settling ponds by a suitable sludge pump. It is not necessary to shut down the system during this operation. The screw conveyors only, are stopped for a few minutes. This arrangement has solved a very difficult problem.

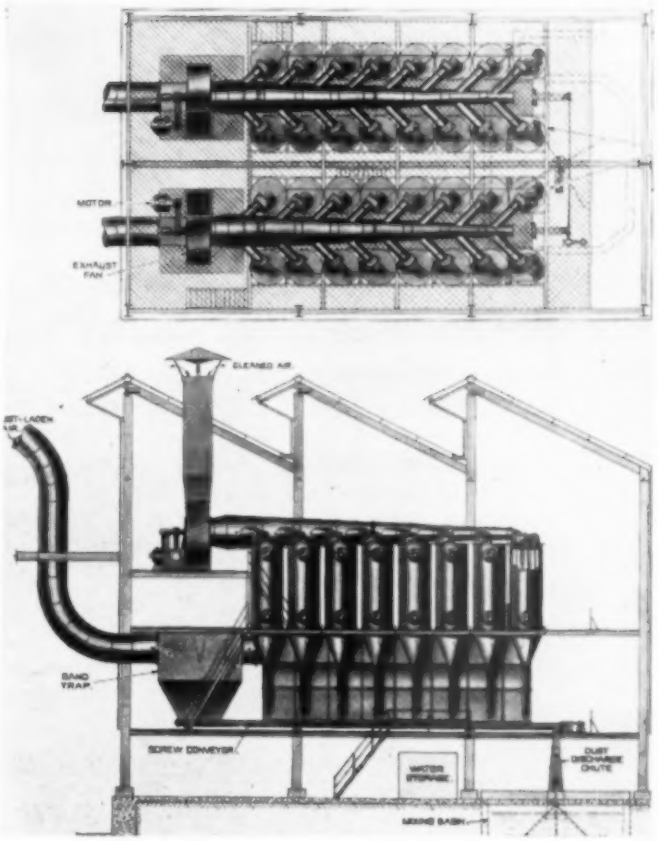


Fig. 2—Diagram showing the layout and construction of the filter units, fans and the mixing basin

It will be noted from the accompanying table that the bulk of the load and temperature (11.8 grains and 185 degrees Fahr. temperature) is handled by the west unit. This is due largely to shop conditions changed since the installation was made. Two schemes now are under consideration for dividing the dust load and temperature equally between the two units. One scheme would change some of the air ducts leading to the various points of collection. The other would provide a single mixing chamber connected to both filter units.

Table I

Details of Operation of Dust Collecting Units

	East Side	West Side
Total passing 325 mesh sieve	53.4	60.0
Total passing 200 mesh sieve	74.8	78.0
Total passing 100 mesh sieve	89.8	92.5
Total passing 40 mesh sieve	98.0	99.6
Static suction at fan, (inches water)	6½	6½
Static suction at manifold (in. water)	1¾	1½
Static drop through filters (in. water)	4¾	5
Temperature air in intake (degrees Fahr.)	117	185
Temperature air in outlet (degrees Fahr.)	109	149
Temperature drop in filter (degrees Fahr.)	8	36
Dew point (degrees Fahr.)	82	96
Safety margin over dew point (degrees Fahr.)	26	58
Area bag surface, square feet	5280	5280
Air handled, cubic feet per minute	23,500	16,000
Air per square foot filter, cubic feet per minute	4.4	3.0
Brake horse power of fan	43.0	31.4
Dust collected per minute, pounds	14	27
Grains per cubic foot air	4.1	11.8

Dust was taken from each screw and represents the total collection of sand traps and filters.

Unit Operates Continuously

After 20 months operation this equipment has proven satisfactory in every respect. The guaranteed efficiency was 99 per cent. This feature is difficult to check, but it is believed that this efficiency is exceeded. There is no dust visible in the discharge from the fans. Ability to function at continuous 24 hour operation is essential to the plant requirements.

The unit construction which allows isolation of individual compartments for bag replacement or repairs during the operation is a striking advantage which eliminates costly shut-downs. It is interesting to note that notwithstanding the extremely abrasive material and comparatively high dust content of the air at high temperatures, bags give efficient service for 15 to 18 months.

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the following advisory staff: Steel, John Howe Hall; Malleable, H. A. Schwartz; Gray Iron, John W. Bolton; Nonferrous, Charles Vickers.

Magnesium Is Used as Alloying Agent with Aluminum

What proportion of magnesium should be used with aluminum as a deoxidizer? Also, what results can be expected from using that metal in this way?

Magnesium is not used as a deoxidizer in aluminum, but rather as an alloying element. However, some observers claim that 0.10 per cent magnesium added to aluminum causes greater fluidity and, with thin sections and complicated shapes, decreases the misruns. Several patented aluminum alloys containing about 0.25 per cent magnesium have high strength and toughness, which is obtained by proper heat treatment. One of these alloys contains 10 per cent copper; 1.25 per cent iron; and 0.25 per cent magnesium, and may be purchased from the producer for foundry use. Another alloy contains a similar amount of copper and magnesium, but no iron.

Base Melting Capacity On Cross Section of Cupola

What is the melting capacity of a cupola 26 inches diameter inside the lining? At present the iron comes hot enough, but I should like to see it come faster.

Hot iron is the principal consideration. If your cupola is performing satisfactorily in that respect, it is doubtful if you can improve on it. Theoretically a cupola should deliver 10 pounds of iron per hour per square inch of area at the melting zone. That is the accepted rule on which to base calculations, but many variables incident to individual construction and operation may affect the result. The area of a circle is found by multiplying the square of the diameter by 0.7854. Thus the area of a 26-inch diameter cupola is 26 x 26 x 0.7854 = 530.9304 square inches. This area in turn multiplied by 10 is 530.9304 x 10 = 5309.304 the number of pounds per hour which the cupola theoretically is capable of melting. However, in actual practice it has been found that an output of 8 pounds per square inch per hour is nearer the mark than 10. Thus the formula becomes 26 x 26 x 0.7854 x 8 = 4247.4432, or approximately 2 tons per hour.

Steel Pinholes Caused By Improper Sand Conditions

We are sending a specimen which is a fair example of a run we have had for a number of days. Dry or green sand, with or without cores, produces the porous condition. Our practice is acid electric. No change in melting methods or materials used has been made from our previous practice which has given good results. Our facing is quite open and the backing sand on screen test shows 6 per cent passes 100 mesh; 22 per cent passes 80 mesh; 72 per cent passes 40 mesh, and 6 per cent remains on the 30 mesh sieve. Moisture is 4 to 6 per cent. Specimens sent were made in green sand with an oil sand core, and poured at 2700 degrees Fahr. We notice a restless condition of the metal as it enters the riser. Though the casting is porous, generally but not always, around the riser and through the cope, the riser itself is free from porosity.

Examination of the specimens indicates pinholes are due to molds being too wet, or too hard and tight, or both. Defects are not of the type which are due to gases in the steel. No figures are given on the strength or permeability of either the facing or the backing sand, and screen test mentioned does not give a true picture of the size of the sand. You do not state whether the moisture content of 4 to 6 per cent applies to the facing or the backing sand, but we assume that it is the backing sand. If the facing sand is as moist as that, you need look no further for the cause of the pinholes.

While you state that the facing is quite open, it should not be forgotten that an open facing will not vent freely if the backing sand behind it is tight. In fact a mold made with an open

facing and a tight impervious backing sand is almost worse than one with a tight facing. The fact that pinholes are more abundant immediately around the riser than elsewhere on the cope side is likely due to the fact that the sand is rammed extremely tight, and probably made extra wet by the molder at that point in fixing up the mold after the cope has been lifted off.

Steel Added to Charge Does Not Affect Annealing

Have you data regarding annealing of cast iron containing 25 per cent steel in the mix, for the relief of strains, etc.? Is there any data available on the annealing of cast iron with various percentages of steel in the mix?

There should not be any great difference in temperatures required to anneal castings containing different percentages of steel in the mix, unless the quantity of steel is such as to change the structure of the iron from gray to mottled or white fracture. In those cases the temperature will have to be considerably higher.

Annealing to relieve strains usually is carried out at 900 degrees Fahr. To soften the iron completely the temperature should be over 1350 degrees Fahr. Partial softening can be accomplished somewhat below 1350 degrees Fahr., but total softening needs 1400 to 1500 degrees Fahr. If chilled or mottled iron is to be annealed the temperature usually is 1600 to 1700 degrees.

Blast Furnace Metal Is Not Poured into Castings

Can you give me any information on using metal direct from the blast furnace for pouring castings in the foundry? I have in mind particularly utilization of this metal in a radiator foundry designed for the production of 400 tons of castings per day.

Probably at one time or another in his career, every foundryman engaged in melting large quantities of gray iron has speculated on the possibility of utilizing molten iron direct from the blast furnace and thereby cutting out all the intermediate expense of casting the iron into pig molds, stacking, shipping, weighing and remelting in the cupola. In some foundries particularly those connected with large iron and steel plants, direct metal from the blast furnace is used for pouring ingot molds, stools and many of the large rough castings.

In a few instances courageous managers of plants engaged in the production of other lines of castings have spent considerable sums of money in trying to develop a method whereby a certain amount of direct metal could be added to cupola melted metal and used as a mixture in that manner. With one notable exception all these attempts have been abandoned either as impossible, or, economical. Usually a combination of mechanical trouble, and cold metal condemned the method and forced it into the discard.

In the Ford process as practiced in the past at the Rouge plant, blast furnace metal and cupola metal in the approximate proportion of 40 per cent of the former and 60 per cent of the latter were poured into a 400-ton mixer. From the mixer the metal is removed 15 tons at a time and dumped into an electric furnace where it is raised to a proper pouring temperature. It is taken from the electric furnace in 1-ton ladles and distributed by monorail to the various pouring stations. A detailed, illustrated description of the installation and process was published in THE FOUNDRY, Sept. 15, 1927.

Austenitic Cast Irons Contain High Nickel Content

A few months ago I saw reference to austenitic cast irons, and I would like to obtain further information on that material.

Austenitic cast irons are obtained through the use of high nickel content. One commercial grade of that iron contains from 12 to 15 per cent nickel, 5 to 7 per cent copper, and 1.50 to 4.0 per cent chromium. Total carbon content will range from 2.75 to 3.10 per cent; silicon from 1.25 to 2.0 per cent, and the manganese around 0.60 to 0.80 per cent.

Austenitic cast irons of that composition are claimed to be considerably more corrosion resistant to many media than plain cast irons, and

Night view of the beautiful Westinghouse memorial in Schenley park, Pittsburgh. The monument is of cast bronze with gold leaf lavishly employed

are said to possess good resistance to growth and scaling up to 1500 degrees Fahr. The irons are nonmagnetic, and have a coefficient of thermal expansion for temperatures up to 1100 degrees Fahr. about 50 per cent greater than ordinary irons.

Pure Copper Used For Anodes in Plating

We would like to obtain the formula used in making copper anodes.

About the best copper anodes are made from electrolytic cathodes by cutting them up to size. Copper cathodes have high conductivity and the little lumps and other inequalities that exist on the sheets increase the anode surface. Also, rolled copper sheets or rods of high conductivity are used.

Cast anodes usually are less pure as the copper must be deoxidized to obtain solid castings. The conductivity may be anything depending on what has been used to deoxidize the copper. The addition of about 3 per cent zinc will give a solid cast anode of nice appearance, and in case of anodes used for brass plating, would probably be quite satisfactory. For high grade cast anodes melt electrolytic copper and deoxidize it with 4 ounces of silicon-copper containing 10 per cent silicon per 100 pounds of metal.

Patternmaking Gear Data May Be Obtained

As a patternmaker I found a recent article in THE FOUNDRY by J. G. Fitzpatrick on the construction of a worm gear and worm, clear and instructive. Have you ever covered the layout and construction of other types of gearing from a patternmaker's standpoint? I shall appreciate any advice on where I can secure this information.

Articles on gear making from the patternmaker's standpoint have appeared frequently in THE FOUNDRY. In the Aug. 15, 1928 issue a detailed description of laying out and constructing a bevel gear was presented. A similar article dealing with shop features of a rack and pinion was published in the Dec. 1, 1929 issue. Practically all text books dealing with patternmaking devote one or more chapters to the theory and construction of gears.

The *Foundrymen's Handbook*, a complete reference library for all those engaged in the casting industry devotes 40 pages to references for patternmakers: This patternmaker's section includes material under the following heads: Recommended pattern equipment, care of glue in the pattern shop, board feet in pattern lumber, lengths of chords for spacing circles, chords of angles from 1 to 90 degrees, table dimensions of polygons, outside diameter of polygons, lengths of sides of polygons, patternmaker's table for rounding corners, standard method for dimensioning diameters, standard method for dimensioning radii, patternshop geometry, tapers and angles, table of sines, tangents, chords and circular arcs, finding lengths of chords, standard foundation washers, standard wood washers, epicycloidal gear teeth, miscellaneous data for the patternmaker, barrel patterns. A colored insert shows the standard pattern colors adopted by the joint committee on pattern equipment standardization.

Chromium Hinders Graphitization Process

We operate a malleable foundry using a duplex process, and would like to know what annealing cycle will be satisfactory for iron containing 2.80 to 3.10 per cent carbon; 0.80 to 0.20 per cent silicon; 0.30 per cent manganese; 0.10 per cent phosphorus; 0.02 to 0.10 per cent sulphur, and 0.05 per cent chromium. Will any difficulty be experienced in annealing malleable without sulphur, and what change in process is recommended when chromium is added to the iron?

Cupola malleable usually requires higher temperatures in annealing than those used with air furnace iron. Therefore, it is suggested that the holding temperature be maintained at 1700 to 1750 degrees Fahr. for about 45 to 60 hours. The proper length of time will have to be determined by removing test bars at regular intervals from the annealing oven for a number of heats, and noting the progress of graphitization. Then the temperature is lowered at the rate of 8 to 10 degrees per hour to 1275 degrees Fahr. When that temperature is reached the doors are opened.

While it is possible to produce malleable iron in the duplexing process through desulphurization with a sulphur content as low as 0.01 per cent, desulphurization usually is not carried beyond 0.04 per cent as no advantage is obtained. Since it is commercially impracticable to produce iron without sulphur that mentioned in your analysis, should produce no difficulty in annealing the iron. Sulphur and manganese retard graphitization. With low sulphur part of the retarding influence is removed, and it is suggested that you reduce the manganese accordingly using Gilmore's formula which appeared in the Sept. 15, 1927 issue of THE FOUNDRY. His formula for cupola melted malleable is that the manganese should equal 1.7 times the sulphur content plus 0.2.

Chromium stabilizes the carbide formation, and for that reason is not a welcome addition to malleable cast iron as it hinders graphitization although it is said to increase the strength. Considerable difference of opinion exists as to what constitutes the limiting amount before annealing difficulty is encountered. Some state that 0.01 per cent is harmful, and others say that the chromium content may be as high as 0.07 per cent. Schuez and Stotz in *Der Temperguss* mention a heat of malleable iron containing 0.08 per cent chromium which remained hard in the center after annealing, and required many replacements due to complaints on toughness and inferior machinability. Since there is a difference of opinion on the amount of chromium which the iron may contain, you will have to determine by experiment just what changes in annealing practice may be necessary. If the amount of chromium (0.05 per cent) contained in your product appears to retard graphitization, it will be necessary to extend the time of holding, or perhaps increase the temperature.

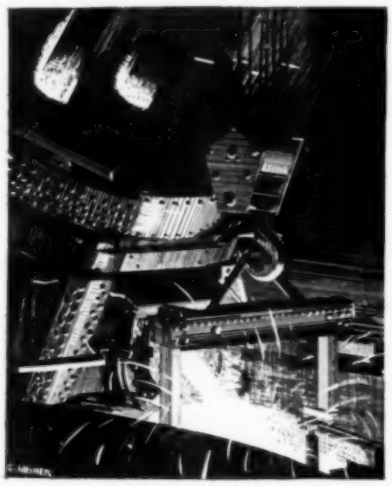
Pressure Is Too High for Good Practice

We operate a 42-inch cupola with six 4 x 15-inch tuyeres located 14 inches above the bottom. Our gages show 14 ounces blast pressure and a volume of 3400 cubic feet per minute. We use by-product coke of the following analysis: Carbon, 90 to 92 per cent; sulphur, 0.55 to 0.65 per cent; ash, 7 to 8 per cent; volatile matter, remainder. How does this check up with average practice?

Theoretically 160 pounds of carbon and 1840 pounds of air at 60 degrees Fahr., are required to melt 1 ton of iron. At 60 degrees Fahr., 1840 pounds of air equals 24,000 cubic feet. With coke containing 90 per cent carbon 160 pounds of carbon means 177 pounds of coke. A 42-inch diameter cupola inside the lining has a melting capacity of 14,000 pounds, or 7 tons per hour. Therefore, the amount of air required may be set down as: $24{,}000 \times 7 \div 60$ or 2800 cubic feet per minute.

However, in practical operation it has been found that all the air driven into the cupola is not utilized. For that reason it is customary to reckon the amount of air required to melt 1 ton of iron as 30,000 cubic feet instead of the theoretical 24,000 cubic feet. Reduced to cubic feet per minute, this will work out as 3500, only a little more than you are using at present. However, and this applies particularly to semisteel mixtures, your blast of 14 ounces is too high and this increases the tendency of the iron toward hardness and shrinkability. A pressure of 10 to 12 ounces is sufficient.

Viewing Foundry Developments



—Courtesy Charles Perry Weimer

At Short Range

CARBON in highly super-heated electric furnace iron is dissolved intimately in the liquid and on cooling precipitates graphite in small and nodular rather than in flakey form. This condition exists if the metal is allowed to cool naturally to the desired pouring temperature. However, with addition of metallics containing graphite in the large flake form, including pig iron, cupola iron or ferro-alloys, the graphite in the entire bath of electric furnace iron will reverse to the familiar flakey cupola form.

♦ ♦ ♦

Introduction of a new cast alloy steel guide shoe has permitted economies in seamless pipe manufacture. Reports indicate the average life of guide shoes approximately 3 hours and that a shut down of the mill for about 15 minutes was necessary in changing shoes. The new development is said to enable the mill to run as high as 8 turns or 10 hours before making a change.

♦ ♦ ♦

IDEAL open-hearth bottom material, comments an open-hearth steelmaker, is commercially pure magnesium oxide and the older the bottom becomes, the more the normal penetration of iron oxide in the bath lowers the fusion point. Therefor any calculated thermal conductivity should take into consideration a sufficient allowance for this particular condition.

♦ ♦ ♦

Rustless scrap now is being melted without changing its chemical composition in electric furnaces of the coreless induction type. The melting chamber is lined with a basic refractory composed of 60 per cent magnesia and 40 per cent alumina which is resistant to slag and neither expands nor contracts to any great extent through the range of room to pouring temperatures. In one installation 76 4-ton heats of stainless steel valued at $112,000 were poured from one lining.

♦ ♦ ♦

A large electrical firm operating its own foundries has eliminated molding difficulties, and in some instances reduced molding costs considerably by submitting all engineering drawings for castings to a foundry expert. He checks them from the molding viewpoint, and suggests changes which will simplify the production problem.

♦ ♦ ♦

ONE automobile manufacturer is using a combined front wheel brake drum and hub cast in one piece. The standard material is malleable cast iron and contains 2.00 per cent carbon, and 1.75 per cent silicon which is subjected to an 8-hour anneal. To obtain higher brinell hardness 0.25 per cent malleable is added to that base mixture. Another variation is the addition of suitable amounts of copper and manganese to the base iron. All irons mentioned are annealed for 8-hours.

♦ ♦ ♦

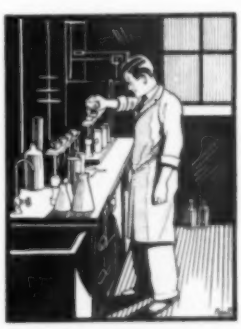
A producer of electric furnace castings experiencing great difficulty obtaining 3.40 total carbon in 2.60 silicon iron after experimenting with many kinds of recarburizing compounds finally chose tar plant soft pitch coke after which they were able to obtain carbons ranging 3.50 to 3.65 with silicons ranging 2.50 to 2.70. They report that the inherent surface chill hardness also disappeared after using the soft pitch coke. This company employs 30 per cent steel in its charges.

♦ ♦ ♦

In a prominent Midwest steel foundry the labor of handling the charges for an electric furnace is reduced to a minimum by the use of a slanting platform in the stockyard. This platform is divided into several compartments for the reception of various classes of materials. These materials are unloaded from the incoming railroad cars by a magnet attached to a crane. A long steel plate charging pan, loaded on a buggy is laid alongside the platform and loaded by an employe who pulls the loose material down with a long hook. Gravity does most of the work. When the pan is loaded it is pushed close to the furnace where it is picked up by a crane and where the nose is inserted in the charging door of the furnace. The after end then is elevated and the charge slides into the furnace.

♦ ♦ ♦

BECAUSE its practice in pickling small gray iron fittings is unusually severe, a southern manufacturer of pipe and fittings recently purchased pickling baskets fabricated from monel metal. The castings are dipped first in 5 per cent sulphuric acid solution at 70 degrees Cent. for 5 minutes, then washed in water. Next they are dipped in 4 per cent hydrofluoric solution at 60 degrees Cent. for 45 minutes, then washed in water. Finally, they are dipped in a 12 per cent muriatic acid at 50 degrees Cent. for 3 minutes. In each of these operations the baskets are revolved end over end to permit the fittings to receive the full effects of the acid. From present indications monel metal will meet these extreme service conditions successfully.



♦ ♦ ♦

Manufacture of camshaft, crankshafts, a new line of products for the Campbell, Wyant & Cannon Foundry Co., Muskegon, will be started soon on a production basis. A new alloy gray iron, to be known as "Broseral" has been developed during the past six months to be used in the new products.

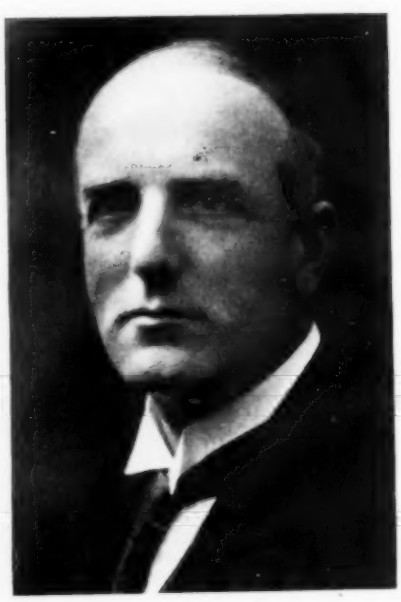
The FOUNDRY Family Photograph Album

Upper Left
A. H. KRAMER
Advance Foundry Co., Dayton, O.

Upper Right
FRED GROTTS
Continental Roll & Steel Foundry Co., East Chicago, Ind.

Lower Left
NEIL E. SALSICH
Jeffery Mfg. Co., Columbus, O.

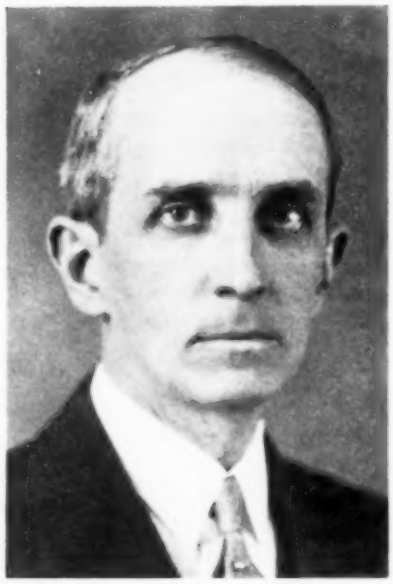
Lower Right
A. HARLEY
Daimler Co., Coventry, England



Men of Industry

Whose Activities Are Making Foundry History

SAMUEL R. ROBINSON, for the past 13 months foundry engineer, alloy foundry, Babcock & Wilcox Co., Barberton, O., recently resigned. Mr. Robinson received his engineering education at the Virginia Polytechnic institute and then became connected with the Duquesne Steel Foundry Co., Coraopolis, Pa. as metallurgist, where he remained for 11 years. From 1918 to 1920 he was metallurgist for the Philadelphia Roll & Machine Co., Philadelphia and was engaged in the production of alloy iron and chilled iron rolls. He then



Samuel R. Robinson

became foundry superintendent for the Paper & Textile Machine Co., Sandusky, O. remaining with that company until 1922. From 1922 to 1931 Mr. Robinson was foundry manager and metallurgist for the Industrial Brownhoist Corp., Bay City, Mich.

FRANK BRUNSON recently assumed the management of the Centerville Foundry & Mfg. Co., South Eighteenth street, Centerville, Ia.

D. V. SHERLOCK, for the past ten years superintendent of the Strong Steel Foundry Co., Buffalo, is now affiliated with the Union Steel Casting Co., Pittsburgh as general superintendent.

WILLIAM L. DITGES, formerly vice president in charge of engineering, Mackintosh-Hemphill Co., Pittsburgh, is now affiliated with the Pittsburgh Steel Foundry Co., Glassport, Pa., as vice president.

A. CLARK MOORE has been made president of the Chicago Railway Equipment Co., Chicago, succeeding the late Edward B. Leigh. Mr. Moore has been identified with the company since 1921, serving as vice president until his promotion to executive vice president in 1931.

W. W. MACMILLEN, purchasing agent, National Malleable & Steel Castings Co., Cleveland, was officially presented with the Institute of Scrap Iron and Steel award for 1931 at the banquet of the National Association of Purchasing Agents at Detroit, June 6. Mr. MacMillen received the award as the individual who made the outstanding contribution to the progress and welfare of the scrap industry during 1931.

LEVI HENRY BURKHART, 21 years of age and educated in the Birdsboro, Pa., public schools, won the first prize in the annual contest for steel foundry apprentices conducted by the A.F.A. during the Detroit convention. Mr. Burkhart, employed in the foundry department of the Birdsboro Steel Foundry & Machine Co., Birdsboro, as an apprentice molder, and competing not only with open-hearth foundrymen, but also those in the electric furnace divisions, produced the finest specimen crankshaft exhibited. Pattern was supplied by the association. Last year the Birdsboro company won third honors in the steel apprentice contest.

Made Vice President

E. Kay Ford, for many years representative at Detroit of the Hanna interests, has been elected vice president in charge of sales, Hanna Furnace Corp., succeeding the late D. M. Eddy. P. J. Moran, Buffalo, has been named vice president in charge of operations and William Kerber, Buffalo, has been appointed Eastern district sales manager.

Group Holds Picnic

The tenth annual picnic of the Quad City Foundrymen's association was held at the Blackhawk Hills Country club, Moline, Ill., June 25.

Levi H. Burkhart

Committee arranging for the picnic consisted of R. L. Eichman, chairman, John Ploehn, A. D. Matheson, and Wm. Seiffert.

Buys Western Business

James Jordan Ltd. has purchased the business of Chas. C. Kawin Co. of California and will operate at 3220 East Slauson avenue, Los Angeles, under the same management.

Sullivan Machinery Co., Chicago, has moved its branch office at Knoxville, Tenn., from 623 Market street to suite 803, Medical Arts building.

Reader's Comment

Interesting communications from readers of The Foundry

EDITOR'S NOTE—*Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Discovered— World's Meanest Chisler

TO THE EDITORS:

The writer desires to give certain information to all superintendents and foremen of brass or iron foundries, which pertains to the contemptible methods of certain foundries in obtaining information as to competitors' customers. The method is as follows:

A call comes in for information on castings and proceeds as follows:

"Do you make certain sizes and kinds of castings? The castings required will weigh so many pounds." Goes into lengthy discussion and advises that the inquirer represents some company within a radius of 40 miles of the foundry he is 'phoning. After he gets the information, advises he will send a sample for the company to quote prices from, but before doing so wants to be sure you are capable of doing this class of work and asks that you tell him some of your customers from whom he can get reference as to your ability. The writer gave several names.

Several days pass and no sample is received but shortly after some of the customers whose names were used as a reference call up and advise that a salesman from a western foundry has called on them, telling them, what size and kind of castings they use and quote them prices much lower than local prices. The customer states they know we must have given out the information.

The writer will admit he fell for this line and while we have always been most ready to give information on the 'phone to anyone, we now have instructed our office that no calls will be taken unless the caller leaves a recall number or makes a personal appointment with the superintendent. We have found that another local foundry has had the same experience. If this has happened to any of your foundries will you kindly advise the writer and if you know the name of the foundry so soliciting we would like this also. Will you please print an article in your paper warning others of this, as we think that we are all prone to give any information we can at this time by 'phone as everyone is anxious to get any business they can, by being courteous and obliging. It certainly is a mean contemptible way of doing business.

EARLE W. SHUTLER
James Graham Co.
New Haven, Conn.

The Error Is Ours

TO THE EDITORS:

May issue of THE FOUNDRY contains a mis-statement of my discussion at a steel founders session of the American Foundrymen's association in Detroit. The statement reads—"Mr. Hall claimed that alloy steels now have taken the place once filled exclusively by manganese steel." As you will see, this statement is somewhat vague, and would seem to imply that I believe that manganese steel has been largely replaced by other alloy steels which, of course, is far from being the case.

What I did say was that I was surprised to see brick and tile machinery listed as a successful application of manganese steel in Australia, inasmuch as, for applications involving pure abrasion, manganese steel in this country has largely been replaced by other steels and iron. This, of course, does not apply to abrasion accompanied by heavy pressure and impact, in which manganese steel has as yet found no competitor.

JOHN HOWE HALL
Taylor-Wharton Iron & Steel Co.
High Bridge, N. J.

Dressed Up

TO THE EDITORS:

You certainly have put a new dress on THE FOUNDRY to make it more inviting for your subscribers to read the editorials and advertisements as well.

With kindest personal regards, I am

L. H. WEBER.
Osborn Mfg. Co.
Cleveland

Reminiscing

TO THE EDITORS:

In the summer of 1886 I worked as a molder with the Chicago Crucible Steel Co. in the basement of the Wells building, southeast corner Clinton and Monroe streets. The head of the firm was a Mr. Colcord, a Chicago capitalist. The manager and active head of the business was William Chambers. Later he organized a sand and refractory supply business and was known to thousands of foundrymen all over the country as Uncle Billy Chambers.

To enter the foundry we had to go through the office facing Monroe street, and descend a flight of steps into a room approximately 30 x 50 feet. This room was the foundry, containing a bench on which the castings were cleaned and chipped, a drying oven 5 x 5 x 5 feet, an annealing oven to hold from 1000 to 1500 pounds of castings, a portable forge, four natural draft pit furnaces 24 inches diameter 36 inches deep. The ash pit was covered with wooden planks.

Other equipment included a few new and used 100-pound crucibles, a long tub or water bosh for cooling the tongs, pokers, etc., a few cast iron flasks of various sizes, two wagon loads molding material, ground fire brick, ground crucibles and fire clay. The stock was kept in a wooden enclosure where the charges were weighed and the crucibles filled.

The working force included the melter, a typical son of the old sod from Roscommon, two young sons of the manager, an English helper, a Polish chipper and myself. The business was somewhat run down at the heel. The output of three molders could not pay rent, salaries, wages, buy raw materials, etc., even though steel castings were in demand and customers willingly paid 25 cents a pound for them.

We made the molds one day, dried them over night, took them from the oven next morning, brushed and blew dust and soot from them and assembled them ready for pouring. The molten steel was ready between 11 and 12 a.m. We poured one heat before dinner and if a sufficient number of molds was left, another heat would be taken off in the afternoon. Two furnaces generally were in operation at one time.

Usually no trouble was experienced in melting the steel, except when the melter made too many trips to corner saloon and imbibed too freely of Monongahela or Kentucky rye. The trouble started in the shakeout and there was trouble enough and then some.

Wasters Were Expected

We experienced all the troubles that Mr. Vickers mentions with the molding material, but no one thought of trying anything different. If we had enough good and indifferently good castings by Saturday they were placed in the annealing oven. The front was bricked up and the castings were annealed over Sunday. When a casting was shaken out of the mold, everyone from the manager down expected it to be a waster.

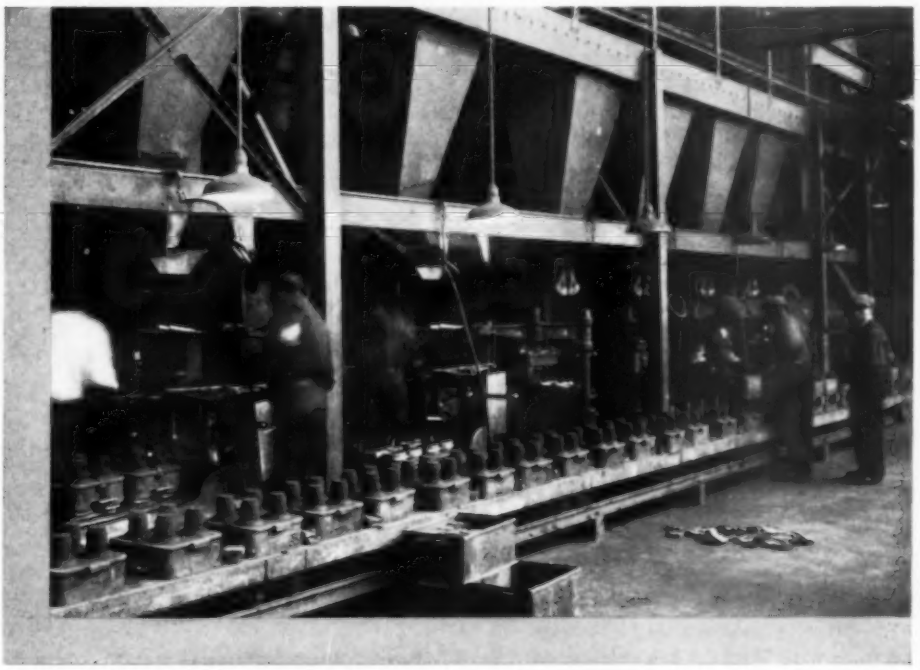
After a pour or *teem* as they termed it, the castings would be inspected by all and sundry. The

FOUNDRY EQUIPMENT

ENGINEERED

FOR HIGHEST QUALITY PRODUCTION

Controlled Production means easier selling for you



QUALITY . . . delivery . . . cost. Every order for castings you go after hinges on these points. Every step you take to improve quality . . . to better delivery . . . to cut costs . . . means that your selling job is easier, your volume larger and your profits greater. And this is just as true whether your foundry is supplying castings to the trade or is handling one step of a complete manufacturing operation.

Bartlett & Snow production equipment for foundries is engineered to give your product every selling advantage. The improvements that it brings to the foundry are just the ones you need to help you increase sales. Quality . . . sand tempered and conditioned exactly to specifications means more uniform castings. Delivery . . . work moves more smoothly and with greater speed through the foundry that is modernized with Bartlett & Snow equipment. Costs . . . lower labor charges, fewer rejects, less waste sand . . . all these represent important savings enjoyed by the up-to-date foundry.

Foundries of every type . . . large and small . . . can benefit by these business-getting advantages of Bartlett & Snow equipment. Let this organization, that for years has led in the application of improved production methods in foundries, tell you about the specific improvements you can expect in your foundry. Write for information.

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melter would comment on the cause of the trouble and invariably finish with: "Men, I know nothing at all about it. I am only telling you how we did it in Philadelphia."

On one occasion I made a smoke cap for a small upright boiler. During the shaking out process the manager noticed the nice smooth skin. "Ted," said he, "It's a dandy!" Alas, he spoke too soon. A crack 2½ inches long was found near the gate. The contraction had been too great and the baked mold had not yielded. In the present welding age it could be fixed easily.

We made a flywheel about 4 feet in diameter with a 2½ or 3-inch rim. The contraction threw the hub out of line with the rim. The manager thought the casting could be straightened by heating. It was placed on the forge and a fire built around the hub. The rim snapped and a section banged against the oven door, barely missing the manager. Mr. Colcord became discouraged and dropped out of the company.

The manager soon interested two other young men in the business and it was run for a short time under the name of Pierce, Brown & Chambers. After dropping their ready cash the new partners withdrew from the venture. Mr. Chambers also stepped out at this time and left all the equipment with the owner of the building.

A molder, LeRoy Kingsland, who had worked for the firm, thought he could run the business. He advertised for a partner. He received several replies and finally got a Mr. Kramer, a dry goods salesman to back him. The firm name of Kramer & Kingsland was painted above the office door. The new management had no better luck than the old. After dropping $1200, Kramer withdrew from the firm.

Decided to Try

About this time I decided to try my luck. I secured permission to take off a heat. I had watched the melting process and had discovered how the crucibles were charged—with the exception of the flux. To this day I don't know what was used.

I had been reading the scanty literature on the metallurgy of cast steel and knew the ratio of the carbon and manganese to add to the boiler punchings to make steel suitable for castings. I went to a wholesale and retail drug store on East Madison street and told the clerk what I wanted—as I remember some kind of potash.

"Potash?" quoth he. "You have been readin' books, hey?"

I did not get what I wanted. However, with the help of Denny the melter who was not particular who hired him, I took off a heat at my own expense and actually sold the castings at $1.50 less than it had cost me to produce them, without counting my own time molding them, etc. I don't wonder the others went broke.

Meanwhile Mr. Chambers had not been idle. He secured the backing of a young business man who still is alive and quite prominent in the affairs of the nation. They rented a building at Fourteenth street and the lake front, fitted it up as a foundry with a battery of furnaces and employed practically the same help. I worked there a short time and did some experimenting with sand, but without success. I became acquainted with silica sand and silica flour a later period, but that is another story. The firm finally went out of business.

Among the many troubles, I don't think the steel or the melting of it was to blame. The quality of the steel was good.

Denny, a burly Irishman of about 50 was the melter. At 6 a.m. Denny and his English helper cleaned the grates and the ashpit. He started the fires with a limited amount of Lehigh large egg size anthracite coal. Four crucibles were placed in a furnace, each crucible charged with 45 pounds of boiler plate punchings, the allotted amount of crushed manganese, carbon and fluxing material. A half fire brick under each pot kept them off the grate. Coal was packed around the crucibles and on top level with the top of the furnace. The fire brick furnace covers were wedged in a clamp with an eye bolt in the center to lift them.

At the expiration of 2 hours Denny pulled the crucibles higher in the fire, covered them again with fuel and allowed them to soak for another hour and a half, by which time the steel was melted. Before pulling the pots from the fire, Denny wrapped a gunny sack around each leg, another over his hands and arms and soaked them with water.

EDWARD GRANT

Kansas State College,
Manhattan, Kan.

EDITORS' NOTE—Recollections connected with the beginnings of the steel casting industry in Chicago were prompted by Charles Vicker's reminiscent articles in the Jan. 1 and 15, 1932 issues of THE FOUNDRY.

THE EDITORS.

More Consideration

TO THE EDITOR:

Of all the panics that I have read about, heard of or gone through, this seems the worst for the foundry industry.

Out of every panic emerges new executives or leaders. This is not an unusual phenomenon for such unsettled conditions and may be attributed merely to human thought, which is responsive to such a change. It is during the depression that officials concentrate on how to correct obstacles that stand in the way of progress.

The first thing that comes to their minds is to censure the old foundry leader. He generally is charged with inability to control successfully such a critical situation. Finally, he is toppled from his pedestal because those in charge believe they no longer can use him. They forget the notable reputation that once stood behind his name and the tremendous production that was realized each month just a few years back, especially during the boom of 1929. The old foundry leader should be given more consideration and efforts made to carry him along in the organization of which he is an outstanding character.

Although this seems to be a hard attitude to assume toward those who undoubtedly have exerted their best efforts to overcome such a crisis, it is a condition attached to fame. After the clouds have cleared away, probably some modifications of this spirit of distrust will be resumed and the old leaders will be reinstated.

Meanwhile other foundrymen will rise as leaders, men who have acquired a reputation for having done something of an outstanding character to cause them to be recognized. Others will be a total failure.

So let us hope conditions soon will take an upward trend and everybody will be satisfied.

Milwaukee CHARLES J. SIEGLE

Propose Specification

Federal specifications board is adopting and promulgating purchase specifications for the type of cast iron pipe having bolted, integral, machine-tapered joints in 6 and 12-foot nominal laying lengths. The specifications, in the formative stage, are being submitted to representative manufacturers for their comment and criticism. The proposed specification covers material and workmanship, general requirements, dimensions, etc., and will govern the purchase of that commodity by the various departments and establishments of the U. S. government.

Moves Offices

E. A. McCallum, representing Roots-Connersville-Wilbraham, Connersville, Ind., has moved his office from Los Angeles to San Francisco and now is located in Room 620 Hearst building. Other changes in addresses of representatives of that company are as follows: B. T. Ehrnman now is located at 3300 Morganford road, St. Louis; and C. B. Coldwell has moved the Texas office to 307 Southland Life Insurance building, Dallas, Tex.

Prevent Losses with

Proper Gates and Risers

By PAT DWYER

ATTENTION is directed to another form of shrinkage defect inherent to the metal itself and depending in no manner on the sand. In some instances the molding method is a contributory factor in that the casting is poured in a position which attempts to defy one of the natural laws. The subject has been covered by many writers in descriptions that range from brief practical application, to abstruse technical and highly scientific theory. For the benefit of readers who have not seen any of this material, practical men interested more in actual causes and results than in scientific theory, the following observations of a navy yard master molder are presented. The original article appeared in the June 1, 1925 issue of THE FOUNDRY:

The theory regarding drainage of the eutectic portion of the metal downward after crystallization and the consequent minute crevices or intercrystalline cavities left in the drained portion of the metal, is logical and can be substantiated by careful inspection of sound and leaky brass castings.

This drainage or setting of the eutectic is particularly noticeable in a light bushing connected to a heavy flange. In an exaggerated case of this description, considerable difficulty was experienced in obtaining sound castings. The light bushing end passed the hydrostatic test after the casting was machined, but the heavy end leaked under pressure. Large risers and heavy chills were required to produce sound castings.

Drainage of the eutectic or intercrystalline shrinkage should not be confused with regular shrinkage. The former takes place after the crystallization period. Metal shrinkage in the general sense is the shrinkage during the period of crystallization.

Rolled material usually is specified for tube sheets. Sometimes, due to lack of this material, cast metal is utilized. Few castings of plain appearance cause so much grief among foundrymen. Well made molds properly vented and dried produce apparently excellent castings which pass the preliminary hydrostatic test only to fail when retested after the tube holes are drilled and tapped. Invariably the defect appears in the center of the casting approximately half way between the plane surfaces.

Usually these castings are poured in an inclined position with gates at the lower and risers at the upper end. A riser at the center stops ordinary shrinkage but does not guarantee a solid casting.

Gravity Plays Part

IN MANY instances mysterious porosity may be traced to a drainage of the eutectic from certain parts of the casting after crystallization has set in. Forewarned of this danger the foundrymen can take certain steps, usually in changing the position of the pattern or the mold, to prevent any marked migration of certain elements in the metal, from one location to another in the casting. Pouring a large disk on edge is cited as an example. Interesting detail is presented of the gating method employed on a bronze hydraulic cylinder 21 inches inside diameter, 10 feet in length and ⅜-inch thickness of metal. Stick brass although apparently the simplest and most innocuous form of brass casting, presents certain features which must be taken into account, both in making the molds and in melting the metal. Adequate feeders must be provided to compensate for the loss of volume in shrinkage.

Poured on Edge

Experience has shown that the best method is to pour these castings on edge. They are molded horizontally in strong iron flasks and then turned up in a vertical position before the metal is poured into the molds. Gates and risers are located on top.

When poured in a horizontal position the center remained hot after the remainder of the casting had passed the crystallization period. The eutectic portion drained from the center, gravitated toward and filled the interstices between the metal crystals. This action was assisted by the fluid pressure of the metal in the riser until a thin shell had formed around and immediately under it. This cut off the supply of eutectice before the center of the casting had solidified and left an intercrystalline shrinkage.

While on the subject of eutectic drainage attention is directed to the advantage of top pouring. The hottest metal always is at the top to insure ideal feeding conditions. The falling metal sets up an agitating or churning effect which helps to produce sound castings.

Long bushings usually referred to as sleeves or liners, sometimes are cast through a set of pop gates while lying in a horizontal position. In other instances the mold is inclined more or less from the horizontal. With a rigid flask, dry sand mold and dry sand or loam core it is possible to secure satisfactory castings gated in this manner. The probabilities are not so good with a green sand mold.

The centrifugal method where a given amount of metal is poured into a rapidly whirling mold, produces the highest type of sleeve or liner castings. However, centrifugal equipment is not available in every foundry, but castings which pass all the usual tests are made by pouring the metal into vertical molds through a ring of pop gates. These castings range in size from 10 to 36 inches diameter and from 2 to 10 feet in length. Method of gating a typical casting of this kind is shown in Fig. 164, taken from a paper presented at Chicago convention of the American Foundrymens' association 1931, by J. E. Crown, United States naval gun factory Washington.

Molded Horizontally

This casting for a hydraulic cylinder is 21 inches inside diameter, 10 feet in length average wall thickness ⅜-inch and weighs 2000 pounds. It was cast in a dry sand mold from the following bronze mixture: Copper 87.25 per cent, tin 9 per cent, zinc 3 per cent and nickel 0.75 per cent. After it was machined the casting was subjected to 300 pounds per square inch pressure test.

The mold made from a split pattern was dried, cored and assembled in a horizontal position and then was turned up on end before the metal was poured into it. An 8-inch exten-

sion on the pattern served as a riser or feeder. Feeder, runner, gates and sprue were all formed as part of the mold, consequently were clean and dry when the mold was closed.

A dried, brick lined reservoir was erected above the mold with sufficient capacity to hold all the metal required. A graphite stopper closed the opening in the bottom of the reservoir leading to the sprue on the mold. Under this arrangement the metal entered the mold quietly and at a definite temperature, in this instance 1950 degrees Fahr. The metal first dropped into a 3-inch diameter sprue which extended 12 inches below the runner to form a well and thus insure quiet entrance of the metal into the runner, a circular channel formed in the sand of the core print. From the runner the metal entered the top of the mold through 24 gates each ⅜ x 1-inch. The aggregate volume of the gate space was one half greater than the volume of the runner. The interior of the casting was formed with a loam core which insured accuracy and uniform metal thickness.

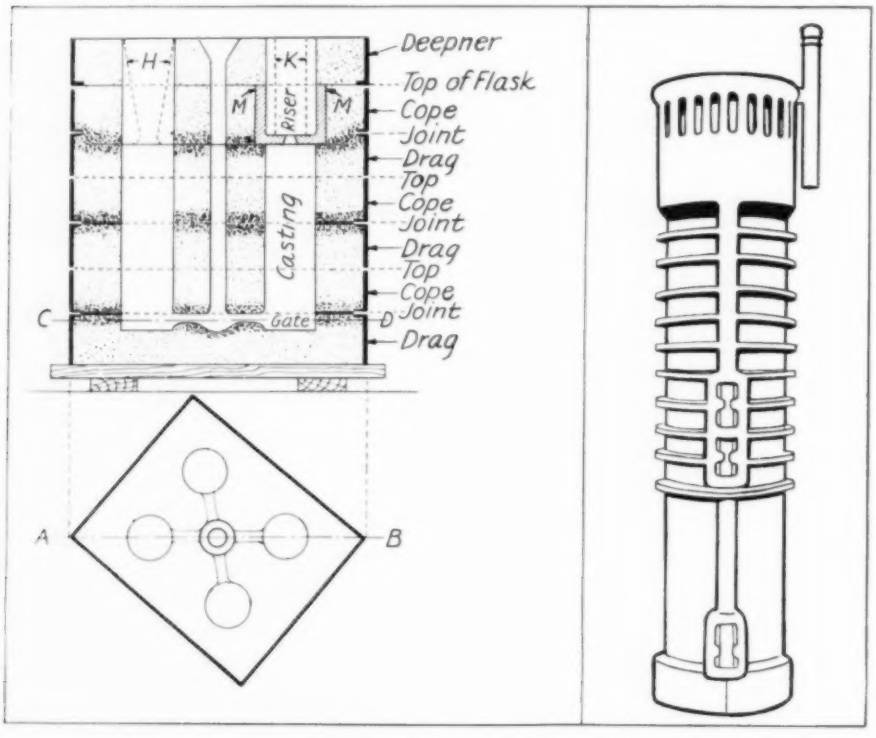

Fig. 163 (Left)—Vertical method of molding sticks. Fig. 164 (Right)—Down gate is connected to circular runner around core print

Bronzes Are Difficult

Manganese bronze and aluminum bronze differ to some extent from other brass and bronze mixtures and must be handled in the molten state carefully. This is due to the saponifying effect of aluminum which converts the molten metal into a mass resembling soapy water. The least agitation causes the metal to foam and the foam in turn solidifies and appears as dross in or under the surface of the casting.

These oxide inclusions are a common phenomenon in manganese bronze rollers, say 7 inches diameter, 9 inches in length, 1¼-inch diameter core in the center, molded on end, gated at the bottom and fed through a large riser on the top.

Gating Method Is Wrong

Metal rushing into the mold from several streams set up a commotion, billow up against the core and produce dross which clings to the core and mold surfaces as the metal rises. The gate should be designed and applied in a manner to insure quiet entrance of the metal. Usually—as mentioned elsewhere—a horn gate on the bottom, with the outlet larger than the inlet, is the best gate for this type of casting.

Although the point has been touched upon before it always is apropos to direct attention to the conditions of the mold. Manifestly even a perfect gate will not insure a perfect casting if the walls of the mold are too damp, too hard, or if the sand is too fine. The metal from the perfect gate may enter the mold quietly, but it will not remain quiet in a wet, hard, or tight mold. Incidentally common salt is employed for a flux and the proper pouring temperature of the metal is when the metal flares a little when the surface is disturbed by the skimmer.

Even with such apparently simple castings as plain *sticks*, special gates and risers must be applied if the manganese bronze is to meet the specifications adopted for any particular alloy. The ordinary run of sticks usually are cast from a red brass either hard or soft, known respectively as *ounce* or *key* metal, and conforming to the following composition: Ounce metal, also known as 85-three-fives: Copper 85 per cent, tin 5 per cent, lead 5 per cent and zinc 5 per cent: *key* metal: Copper 80 per cent, tin 10 per cent, lead 5 per cent and zinc 5 per cent. Key metal is harder and denser than the familiar 88-10-2 mixture—copper 88 per cent, tin 10 per cent and zinc 2 per cent, and is much easier to manipulate. Usually the castings are sounder and they machine more readily on account of the lead content.

Small sticks usually present no difficulty in casting. The flask is filled to capacity with patterns arranged in parallel formation. A long runner across one end supplies metal to the molds through a series of small gates, one to each stick.

Large sticks, from 2 inches diameter upward, cast in the position shown in Fig. 165 may show a shrinkage depression as at C. Usually a defect of this kind can be traced to a desire on the foundryman's part to reduce the amount of metal in the gates and risers. When carried too far, this practice will defeat its own object since the castings will be defective.

Report on Loss

Several years ago H. W. Gillett, at that time connected with the United States bureau of mines, conducted a survey on brass melting practice. The complete report known as *Bulletin 78, Brass Furnace Practice in the United States*, was issued by the department of the interior, bureau of mines and is available to any interested person who will send 45 cents to the superintendent of documents, government printing office Washington. The bulletin contains a wealth of information on every phase of brass melting practice.

In the present instance the publication is quoted as showing that the average proportion of metal melted to weight of castings is 2 to 1. On extremely light castings the rate is 3 pounds of metal melted for 1 pound of casting. A ratio of 3 pounds of liquid metal to 2 pounds of casting is considered extremely low.

The weight of each riser shown to the right in Figs. 165 and 166 is approximately 13½ pounds. With 3½ pounds for the gate and runner the total remelt is 17 pounds compared to the 27 pounds in the casting. This is a little more than the ratio of 1½ to 1, but is considerably less than the common proportion of 2 to 1 and therefore may be considered good, instead of wasteful practice.

Three sticks in a flask as shown in

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Sterling

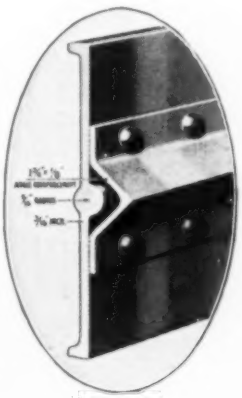
offers you economies—that you cannot afford to overlook—in their "*rolled steel*" flasks

No matter from what angle you may figure your flask costs—Sterling "*rolled steel*" flasks will prove their economy and greater efficiency—and on production jobs more especially.

Just check over these points and jot down where expense and loss occurs with your present flasks. Add them up and you have "Sterling's economies" (1) "*Rolled Steel*" is the only material combining great strength and rigidity with light weight. (2) "*Rolled Steel*" can't burn. (3) "*Rolled Steel*" can't break. (4) "*Rolled Steel*" is 50% lighter than cast iron—this alone means easier handling and more moulds per day per man. (5) "*Rolled Steel*" can't twist—is always accurate and level at the parting. (6) "*Rolled Steel*" flasks save on sand and floor space. (7) "*Rolled Steel*" will stand up longer under the terrific abuse of machine moulding. (8) "*Rolled Steel*"—because it is steel gives you a metal of longer life, greater resistance to shocks and hammering and less needs for repairs.

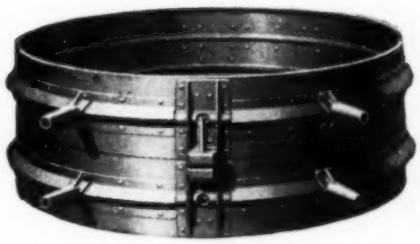
Sterling "*rolled steel*" flasks can be obtained in any size, shape and style—for bench, floor, or machine moulding of any kind of metal.

Below are shown a few of the popular Sterling types—why not write for our complete foundry catalog—sent freely without obligation.



(*Above*) Style GGR—excellent for light floor work or medium size moulding machines.

(*Above*) Style AA—just the type for small and medium size work.



(*Right*) Style BBL—the best flask for circular work. Built in diameters from 18" to 48"

(*Oval*) Sectional view of the "*rolled steel*" construction. The center rib imparts rigidity that means full accuracy at all times—no twist—no strain.

Other Sterling products for foundry use are—Wheelbarrows, Core Barrows, Bottom Board Barrows, Pig Iron Trucks, Slag Buggies, Charging Cars, Flask Pins, Wood Wedges, Shop Boxes, Skim Gates, Flask Bands, Trucks, etc.

STERLING WHEELBARROW COMPANY

STERLING ON A WHEELBARROW MEANS MORE THAN STERLING ON SILVER

MILWAUKEE WISCONSIN

BRANCH WAREHOUSES—BOSTON, NEW YORK, PHILADELPHIA, PITTSBURGH, CLEVELAND, DETROIT, CHICAGO, ST. LOUIS

Fig. 165 show a lower ratio of liquid brass to castings, than two sticks as shown in Fig. 166. Either form of gate shown in Fig. 166 will prove satisfactory. Success of gate *A* in producing clean castings will depend on how clean the metal will run and this feature in turn depends on the zinc content. The long runner with a small gate at the end of the casting farthest from the feeder will produce the cleanest casting, especially if a skim core is placed in the runner. Irrespective of the type of gate, the sprue must be kept filled all through the pouring period from start to finish.

The long runner *A* in Fig. 166 conducts the metal to the lower end of the mold. After that end is filled the metal rises gently in the inclined mold, thus reducing any cutting effect to a minimum.

Require High Head

Practically the same result is secured by gating the castings as shown in Fig. 165. A bushed head is needed on the sprue to bring the molten metal up to the top of the risers at the high end of the flask. Either of these molds could be filled with metal while in a horizontal position, but in this position the force of gravity as an auxiliary feeding agent, would not be so great. As an alternative measure the height of the head might be increased to give added pressure.

Method of molding stick castings vertically, four in a flask, is illustrated in Fig. 163. As pointed out previously the sand should be open, should be worked on the dry side, rammed firmly and uniformly to prevent the castings from swelling, particularly at the lower end. Castings made in that manner are fed through a sullage head and feeder, which merely is a continuation of the mold cavity upward to a height of 6 inches. If the feeder is skimped in height or diameter, the casting will show a pipe *H* at the top and the casting usually has to be scrapped, even after attempts have been made to *burn in* a patch on the top.

The type of riser shown at *K* Fig. 163 sometimes is used, but is not recommended. A riser or feeder is a necessary evil. It should be designed to provide a reserve of liquid metal, free to descend by gravity into any cavity formed in the casting by shrinkage due to solidification. Obviously if the metal in the riser congeals before the metal in the mold, it will not fulfill its expected function.

One method of prolonging the life of the metal in the riser is to form the riser in a dry sand core. One of these ring cores can be placed in the desired position on the pattern and then surrounded by green sand which is rammed in the usual manner in the cope. A riser of that type is shown at *M* Fig. 163. One of its advantages is that the metal can be broken readily from the casting after it has served its purpose and while it is still hot as the difference in section gives a cleavage ring.

Stick brass 3 inches and greater in diameter cast horizontally from miscellaneous junk containing iron and aluminum, may develop peculiar cold shuts on the cope side. Usually this form of defect is due to the fact that the metal in the bar or stick shrinks along the top and then the hollow is filled by metal that flows from other parts of the casting and the riser. This metal has a lower melting point than the metal in the body of the casting. It is rich in tin and other white metals—a brittle combination—a point which may be verified by breaking the loose piece of metal lying on top of the casting.

Book Review

Symposium on the Effect of Temperature on Metals, cloth, 829 pages, 6 x 9 inches, published jointly by the American Society for Testing Materials, Philadelphia, and the American Society of Mechanical Engineers, New York, and supplied by THE FOUNDRY, Cleveland, for $6.15, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster.

While known data on effect of temperature upon properties of metals are meager compared to the demand, considerable progress has been made since 1924, when the first symposium on that subject was held jointly by the American Society for Testing Materials and the American Society of Mechanical Engineers. The present symposium has 27 papers by 38 authors, and the papers mainly are compilations of data gathered from many sources both domestic and foreign.

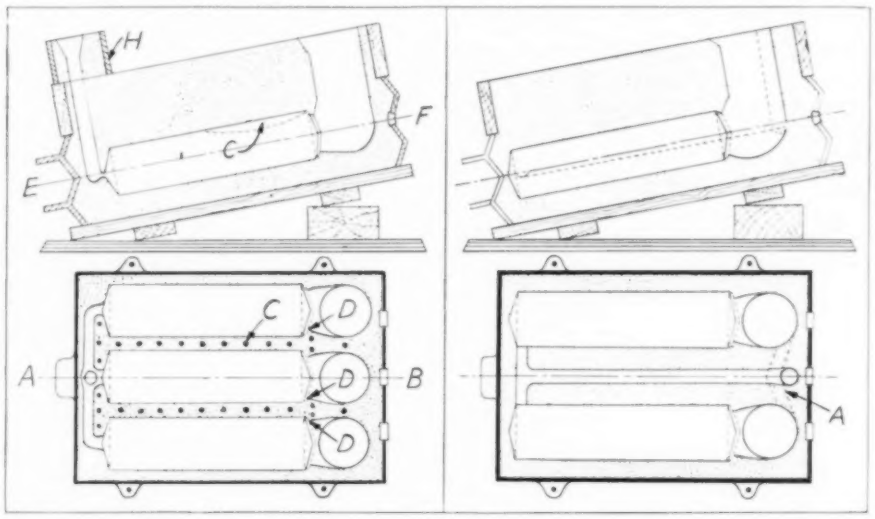


Fig. 165 (Left)—Casting stick brass three in a mold. Fig. 166 (Right)—Casting two in a mold with two types of gate shown

Metal of this kind usually is oxidized and shrinks abnormally on account of the iron. The proper remedy is to use clean ingot or new metal, but if for any one of many reasons, a man is forced to use the hodge-podge from the junk box, he should take extra precautions in melting the metal and making the mold. The gate must be larger than usual and the feeder must be higher and larger in diameter than the feeder on a similar casting made from suitable metal. Preferably the metal should be poured into a sprue connected at the bottom with the base of the feeder. Thus the metal would enter the bottom of the feeder before it entered the mold. Also the feeder would be filled with hot metal at the conclusion of the pouring process.

This is the thirty-first of a series of articles dealing with the various types of gates and risers used in the foundry industry. The thirty-second will appear in an early issue.—THE EDITORS.

The authors are experts qualified to appraise and interpret data of others as well as their own.

The volume is divided into two sections. One deals with engineering trends and requirements for metals at high and low temperatures, and the other with the properties of available metals for high and low temperature service. The volume also includes about 200 pages of discussion on various papers presented, and a bibliography of literature of 50 pages. The book is a valuable addition to any foundryman's or metallurgist's library as a reference for the present properties of metals under temperature service, and for future demands.

Merco Nordstrom Valve Co. has been acquired by the Pittsburgh Equitable Meter Co., Pittsburgh and will be operated as a division of the latter company. W. F. Rockwell has been made president of the Merco Nordstrom Valve Co.

Foundry Industry's Greatest World Traveler

ALMOST 60 years ago—well, 58 if you insist on strict accuracy—what's a couple of years one way or another in the high altitudes—well, anyway it was in the year '74, with the country just emerging from the greatest panic up to that time, that young Charlie Gale secured a job with the Michigan Stove Co., and commenced to learn the noble art of molding and casting metal.

All this happened in the city of Detroit, a fair sized hamlet even in these ancient days, situated then as now on the north bank of the Detroit river. The international boundary line between Canada and the United States follows the center of the river which in this vicinity flows toward the west instead of the south as one might infer from a casual study of the map. Rumors persist to the effect that contraband liquir flows *across* the river in direct defiance of natural and national law. A truly remarkable river any way you want to look at it.

However, attention in this instance simply is directed to a feature it has in common with practically all other rivers, that is it serves as a measure for marking time, particularly if it is spanned with a bridge or stopped by a dam. The Detroit river has no dam and was without a bridge up to comparatively recently, and yet despite that fact, the statement confidently can be made that a considerable volume of water flowed between its banks in the interval marked by Charlie Gale's entrance to the foundry in 1874 and his election to a life membership in the American Foundrymens association in 1932.

What was Chas doing while the aforesaid great volume of water was flowing past Belle Isle, the Detroit Yacht Club and—in recent years—under the Ambassador bridge which links the west end of the city with Sandwich, one of the outposts of the empire "whose morning drum beat following the sun, etc.?"

For the first 50 years he attended strictly to business and confined the scope of his activities to the three neighboring states of Michigan, Ohio and Pennsylvania, in the order indicated. For the past 10 years he has spent comparatively little time in this, his native land. Just drops in once in a while to see if it still is in existence, to attend a convention of the A. F. A. to exchange greetings with the boys who knew him when, and then off again as Stevenson so neatly puts it"To Malabar and Surninam, to Providence and Portobello."

Charlie in Egypt in the shadow of the pyramids

Six or seven months after he disappears friends begin getting post cards from Lapland or Jericho, Hawaii or Hakodate, Auckland or Brisbane, Callao or Hong Kong, Alexandria or Marseilles, Singapore or Sitka.

Whether the card presents a picture of snow covered igloo, a palm tree, a crocodile, a leaping kangaroo or a yodeller in the Bavarian Alps, Charlie never fails to inscribe a friendly message to the effect that he is having a fine time and that he wishes the recipient of the card was there to share it. Practically without exception, particularly during the past two years, the holder of the card has wished the same thing, a modern example of the ancient poetic expression "Two souls with but a single thought."

Travel as a hobby, as a source of inspiration and knowledge, a form of education always has appealed to Mr. Gale and was fostered to some extent by a 15-month period he spent in France and Germany after he had finished his apprenticeship with the Michigan Stove Co., in Detroit. He worked in the foundries of these two countries while absorbing all the impressions which a young tourist naturally absorbs in a foreign country.

Upon his return to the United States he re-entered the service of the Michigan Stove Co., completing a term of 8 years with the exception of the 15 months spent in Europe. He then went with the Michigan

Just another means of transportation which C. H. found in China

Malleable Iron Co., where he remained for 16 years, first as a molder and later in succession time keeper, order clerk, foreman and superintendent. With no further promotion in sight he accepted a position as superintendent of the gray iron and malleable foundries of the International Harvester Co., at Springfield, O., where he remained for five years. In 1904 he was appointed foundry superintendent for the Pennsylvania Malleable Co., later taken over by the Pressed Steel Car Co., McKees Rocks, Pa. He resigned from this connection in 1922 after 18 years service and after 48 years continuous connection with the foundry industry.

He has been a continuous member of the American Foundrymens association since the second year of its existence, when a convention was held in Detroit.

Features Cast Product in Display

Manufacturers of numerous types of equipment are finding it a decided advantage to their sales efforts to emphasize the use of castings in the construction of their product. An interesting example of how foundry operations may be featured in advertising a product is shown in the accompanying illustration, which pictures the booth of the Wilmot Castle Co., Rochester, N. Y., at a recent exhibition of the Chicago Dental Society.

In its advertising folder, the Wilmot company says "The Castle full-automatic sterilizer is now cast in solid bronze, the everlasting metal. In Castle sterilizers you will now find a boiler that has the sides, ends, and bottom all cast in a solid piece. No seams, no rivets, no welds. Because of its rigidity and one piece construction, it will not buckle or warp. Because of its strength and durability, it will last."

The castings used by the Wilmot company are made by Josiah Anstice & Co., 97 Humbolt street, Rochester, N. Y.

Plan Survey of Die Casting Industry

Survey of the die casting industry of the country will be made by the United States commerce department at the request of the American Die Casting institute as an aid to more effective economic planning and individual operation in this field, according to Frederick M. Feiker, director, bureau of foreign and domestic commerce. The American Die Casting institute, which is sponsoring the survey, will co-operate actively in the work, as well as supply funds to cover special expenditures involved. The institute's membership comprises concerns representing 80 per cent of the total output of the die casting industry, estimated normally in excess of $25,000,000 yearly.

The die casting study will apply the lens of scientific merchandising research to operations of concerns engaged in the commercial production of die castings which go into the manufacture of automobiles, radios, household appliances, business equipment, and numerous other articles in everyday use, to mark down the points where additional savings and improvements are possible.

Plan of the survey will consist of two phases; a general study of the industry to be conducted by the questionnaire method, and a special case study of certain specific problems as found in the practice of six or eight specially selected plants.

The commerce department's part in the survey will be under the direction of H. C. Dunn, chief of the merchandising research division, with E. C. Sheeler, chief of the special trade studies section and John Hall, business specialist, in charge. The die casting institute committee co-operating with the department in the survey includes W. G. Newton, president of the institute; Charles R. Murray, and H. R. Rhinehart, secretary.

The art of casting occupied the prominent place in this display

Book Review

Foundrywork and Metallurgy, Vol. I, edited by R. T. Rolfe, imitation leather, 248 pages, 5 x 7¼ inches, published by Isaac Pitman & Sons, London and New York, and supplied by THE FOUNDRY, Cleveland, for $1.75 plus 15 cents postage and in Europe by the Penton Publishing Co., Ltd., Caxton House, London.

This is the first of a series of textbooks, covering many phases of foundry operations, and written by numerous leading authorities on foundry practice in England. Volume I is devoted to detailed information on the fundamentals of pattern making, molding and core making, and machine molding. Other volumes, based largely on this preliminary work, will be published in the near future.

The first section, devoted to pattern making, was written by William G. Walker and discusses pattern lumber, drawings, construction of patterns, pattern plates, strickle work, gear wheels, loosening and lifting plates, storing patterns, costing and numerous types of machinery for the pattern shop.

Molding and core making, the second section of the book, which was prepared by J. Laing, foundry superintendent, W. H. Allen, Sons & Co., Ltd., Bedford, England, considers flasks, molding tools, core making and machines, loose pieces, bedded in patterns, toothed wheels, dry sand molds, loam molding, open sand casting, plate molding, stack molding, venting, gating, risers, weighting, chills and denseners, design of castings, causes of defective castings and a glossary of terms.

The third section, prepared by A. S. Beech, past president, Foundry Trades Equipment & Supplies association, discusses various types of molding machines now available. The work of course represents overseas practice, but the fundamentals involved are the same in foundries the world over. Due to the wide scope, each subject is treated briefly, but concisely.

C. C. Riemenschneider, formerly manager of material handling division, Richards-Wilcox Mfg. Co., Aurora, Ill., has been appointed sales agent for the company for Illinois and Wisconsin with headquarters at 201 North Wells street, Chicago.

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Reconstructed finance unincorporated

The Adventures of Bill

BY PAT DWYER

IF THIS period of depression lasts much longer" Bill remarked "I shall be tempted to try out a remarkably promising financial scheme revealed to me by a lad from Philadelphia at the recent American Foundrymens convention in Detroit."

"Can it be worked by two people?" I inquired "The well known wolf has been seen hovering in the vicinity of the old homestead and I shall be glad of any opportunity that may lead to the replenishment of the ammunition lockers."

"Well" Bill said "I'll tell you. So far as I know the method is not patented or secured by copyright. That in itself is a slightly suspicious feature, but otherwise I see nothing wrong with it. Up to the present I have not given the subject serious consideration, but one of these days I shall put it to the test."

"Before going any farther, before committing myself in this venture to which you so kindly have invited me—"

"Where do you get that invited stuff? If you want to horn in on the racket, that's your own lookout, but if you get stung, don't try to shift the blame on to me."

"I thought you said this was a remarkably promising financial scheme? Apparently there is a catch to it some place. If there is, you can count me out. I appreciate your kindly intention, heart of gold and all that kind of thing, but reluctantly I must refuse, absolutely to join you."

"Down in our part of the country," Bill drawled, "it is not customary to refuse an invitation until after an invitation has been extended. Please correct me if I err in this instance, but so far as I can recollect I said nothing to you about joining me when and if I embark on this financial enterprise. I have no objection to outlining the details of this scheme for acquiring large gobs of wealth, but that is a long way from saying that I want to enlist you as a partner. A year from now when the chauffeur of my gold mounted imported car throws a splash of mud in your eye while you stand humbly by the road side, hat in hand, you will bitterly regret your present haughty and supercilious attitude. This is opportunity knocking at your door and you treat the messenger as scurvily as any knave who might come soliciting you to buy a mouse trap, an assorted package of needles and pins, or an enlarged crayon of your aunt Matilda's photograph."

"All wrong," I hastened to assure him. "All wrong, Bill dear lad. You do me a cruel injustice when you infer that I am not anxious to hear your story. Also, while on the subject of injustices I should like to sound a note of warning for the benefit of your fancy chauffeur. Tell him not to be deceived by my meek and humble attitude by the road side hat in hand. The hat probably will contain a nice assortment of small jagged flints and the old eye and the hand still are in sufficiently close co-ordination to bounce said flints off his knob at any distance under 100 feet. Tell him to watch his step. Tell him—"

"Fat chance any person has to tell anyone anything while you are around. Listen, I had this brilliant financial scheme direct from George Batty in the lobby of the Statler hotel. He

Pick-up and acceleration are synchronized

admitted that up to the present he had not tried it out himself, but that is a factor of minor importance. These highly accomplished lads circulating in the rarified atmosphere of pure science rarely or never allow their minds to descend to pecuniary levels.

"George admitted that he was not personally acquainted with the man who had invented the system and who had—at least on one occasion—demonstrated it to his own satisfaction. However, he was intimately acquainted with the steel foundry in which this alleged financier had cultivated his peculiar talents. Also on many occasions he has viewed the buildings, the pubs and the pawn shops which figure so prominently in the drama. In a word and to be brief, the story is laid in that sterling old town of Sheffield in the black country of England. What more evidence of its authenticity do you want than that?"

"None. Carry on."

"According to George, a worthy citizen who uses a nice discrimination in his choice of words, an artist you might say in spinning a yarn—"

"I have heard him many times." I said. "Consider my opinion as one with yours in all phases of George's proficiency with the English language. Skip all the introduction and raise the curtain on Scene 1, Act 1, Interior of The Sow and Gander."

"The first scene really is laid in the foundry and shows an honest molder—or mowlder, as they say over there—sadly in need of a drink. He has no money and his credit has been exhausted in every pub in the district. At this acute crisis a companion inquired: 'What's ailin' thee, lad?'

"He told him and then started to change from the old ragged breeches into a good pair which he reserved for street wear. The good companion had an inspiration.

" 'Lend me them there breeches for 'alf an 'our' says he 'An' hI'll be back wi' the proice o' 'arf a dozen blinkin' drinks!'

"The first lad said he had thought of that scheme himself, shoving the pants up the spout, but he did not dare go home without them. The financier told him not to worry. By his method he would return the money *and* the pants. With this assurance

the first lad yielded up the precious bundle and sat down to await results.

"The self appointed financial agent pawned the garment for 5 shillings. With this sum in hand well and truly paid he entered a store where goods are sold on the instalment plan and paid 3 shillings down on a 49 shilling clock. He carried the clock to a second pawn shop and secured a loan of 30 shillings on it. With 32 shillings jingling in his pocket he returned to the first pawn shop, repaid the loan of 5 shillings and redeemed the pair of pants. The series of transactions left him with a balance of 27 shillings clear which he generously shared 50-50 with the owner of the original collateral.

"There y'are," Bill concluded in triumph. "What's the matter with that scheme for raising money?"

"The only flaw in that scheme," I said, " is the same flaw that plunged this country into its present depression. When the second instalment fell due on the clock the financial genius had no money to meet it. He could not return the clock because the pawnbroker had it and certainly he would not yield it up until the loan was paid. The net result was that the storekeeper had 3 shillings to show for a 49 shilling clock. The pawnbroker had the clock, but he was out 30 shillings. The two molders had had a few drinks and if the law was allowed to pursue its course, probably were in line for transportation to the modern equivalent of Botany Bay or Van Diemen's Land."

"Oh, well," Bill remarked, resignedly, "I might have known there was a catch to the thing. Hereafter I shall stick to the foundry where I am on familiar ground, instead of trying to find my way through the dense and dangerous financial jungle, filled with wild and ferocious animals, specialists in the art of snapping money from each other.

"Compared to the financial arena, the foundry is a comparatively sheltered place, but even in the foundry, one occasionally encounters difficulties. I had an inquiry some time ago from a man whose cupola practice was not satisfactory. His cupola is lined to about 22 inches diameter above the tuyeres and develops a bridge before he has melted more than one half of his usual 5000-pound heat. As an added aggravation the iron is cold and the castings are dirty.

"His usual practice is to light the bed coke and after it has burned through he adds coke until it reaches a point about 4 feet above the tuyeres. He then charges 300 pounds of iron followed by 35 pounds of coke and 8 pounds of marble, and continues this proportion until the entire amount for the day is charged. The charged cupola is allowed to stand 45 minutes before the fan is started. The first iron appears in about 3 minutes. In an attempt to remedy conditions he raised the coke charges to 45 pounds. The iron is a little hotter than before, but still is not satisfactory. The slag is quite thin and causes trouble by running through the tap hole with the iron. Many of the small castings, particularly small gear blanks show small round clean pockets on the cope side after they are machined and he wonders if this form of defect is due to cold iron.

"In my reply I pointed out that he had omitted many factors that are necessary if one is to make an intelligent diagnosis of the trouble. However, his statement that the coke bed extends 4 feet above the tuyeres and the first iron appears in 3 minutes, leads me to the opinion that the first half of the bed is too low and further, that the tuyeres are left open from the time the cupola bed is lighted until the time the blast is put on.

Like the Hindu for pants he makes his skin do

"Instead of speculating on what he has or has not done I decided it would be more to the point to suggest what he should do to secure satisfactory results from this small cupola. I advised him to charge a sufficient amount of coke on the bed, so that when it has burned through and settled down it will be necessary to add only 10 or 12 inches more to bring the top about 3 feet above the upper edge of the tuyeres. The tuyeres should be closed when charging is commenced, under ordinary conditions, and the wind may be put on as soon as the furnace is filled to the charging door.

"Many melters favor the idea of allowing the charge to soak for varying periods up to an hour before turning on the blast, but this practice is not essential. In effect it is equal to applying a mild blast for a long period. If for any reason the charged cupola must stand for periods over an hour, the tuyeres must be closed. Otherwise the bed will settle and be too low when melting actually commences. The resulting iron will be cold and probably oxidized.

"A 22-inch inside diameter cupola will melt about 2000 pounds per hour which means that this particular cupola will be in blast for nearly 3 hours. Amount of slag produced in that time is sufficient to choke the cupola unless removed either through the tap hole, or, a proper slag hole at the back or side. With a receiving ladle under the spout, slag may be drained through the tap hole and afterward skimmed from the ladle. The method is rather messy and danger always exists that some slag will remain and find its way into the castings.

"A skimming spout may be arranged, but probably the simplest method is to provide a slag hole about 3 inches below the tuyeres at the back of the cupola. Place sufficient limestone or other fluxing material on each charge to form a thin, liquid slag that will flow freely through the slag hole. This point will have to be determined by experience. The usual amount is about one third the weight of the coke charge. The amount gradually may be increased or decreased depending on the fluidity of the slag. A mild blast, say 6 ounces, is sufficient for a small cupola. Scrap and pig iron should be broken into small pieces and charged in a compact manner."

Industry Shows Decline in Injury Rates

Accident frequency and severity rates in the foundry industry declined in 1931, according to a recent report prepared by the National Safety council, Chicago. Based on reports from 140 plants, the frequency rate was 24.19 and the severity rate 2.10. On the basis of 91 plants reporting during the past 3 years, frequency rate in 1931 was 23.62 and the severity rate 1.84 compared with 32.53 and 2.28 in 1930, and 48.20 and 1.95 in 1929.

Injury rates were highest in steel foundries, while brass and aluminum foundries had the lowest frequency rate, and malleable foundries the lowest severity rate. Large organizations had better frequency rates on the whole, and malleable foundries the lower severity rates than the larger ones. A bulletin containing the report and considerable data collected in the survey recently has been published by the National Safety council, 20 North Wacker drive, Chicago.

J. E. Harlow, 7 West Sixth street, Cincinnati, has been appointed representative of the Magnetic Mfg. Co., Milwaukee in the Cincinnati territory. Mr. Harlow will handle the entire line of magnetic equipment made by that company, including separators, clutches, rolls and other magnetic units.

Coreless Induction Furnace

(*Concluded from Page* 15)

and poured. It is then returned to the truck, charged with scrap and is ready for its turn. The shifting of *power off* one crucible to *power on* the second crucible requires only about 15 seconds, and shifts as short as 7 seconds have been clocked. Not only is the annoying and costly job of ladle heating eliminated, but it is possible to run different mixtures from heat to heat.

The volume of refractory, exclusive of the crucible, is small and first heats or heats with new cold crucibles require but little longer than heats in which the crucible is warm. The furnace provides inherent stirring, preventing segregation of elements. Since the heat is generated within the metal (a characteristic of all induction furnaces) the crucibles give long life.

The lift coil type of furnace is not well adapted to steel or cast iron melting because the higher pouring temperatures of those metals makes the crucible difficult to handle with tongs and results in a short crucible life.

Uses Battery of Furnaces

Fig. 3 shows the foundry of the Babcock & Wilcox Co., Barberton, O. Available high frequency sources of power are a 1250 kilowatt, 960 cycle generator and a 150 kilowatt, 2000 cycle generator, which together give a melting capacity of about 2¼ tons per hour. Furnaces in sizes ranging from 400 to 3000 pounds are connected ready to run and by arranging so that several furnaces are ready to pour at the same time, single castings up to 6000 or 8000 pounds have been made.

With such a battery of furnaces, which includes 1000 and 1500 pound units as well, practically any size heat can be made from 200 to 8000 pounds. The foundry can respond rapidly to changes in production schedule and demands for various size heats as well as heats of different analysis can be met quickly.

Ability of the furnace to reproduce results time after time assures constant quality. The balanced three phase, high power factor load drawn from the lines together with the absence of wide fluctuation makes for minimum power charges.

That foundry produces plain carbon steel castings, stainless, heat and corrosion resisting steels, and high speed steel. It has the largest high frequency melting capacity of any in the world producing sand castings.

Coreless induction furnaces are employed by the Hoskins Mfg. Co. at its Detroit plant. The newer of two outfits has a 300 kilowatt generator, motor driven and the furnaces are arranged for alternate operation, are rated 600 pounds. Six hundred pound charges of chromel (80 per cent nickel—20 per cent chromium) of the highest grade are melted in about 1 hour. The older equipment is rated 150 kilowatts, 300 pounds, and melts in about the same time. Equipments are used both for chromel castings and ingots. The

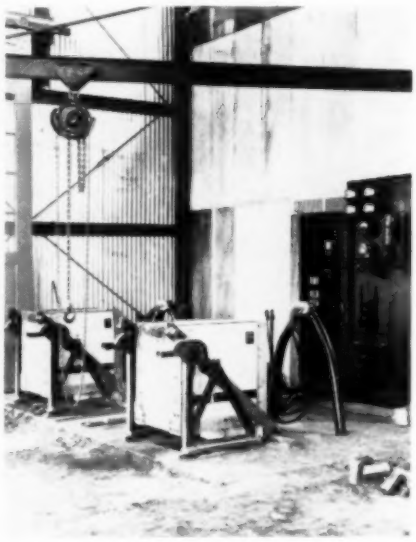

Fig. 5—Furnace installation at the Duriron Co.

tilting hoist is a high speed air hoist with speed control so that the furnaces may be tilted in a few seconds or slower if desired.

Fig. 6 shows the 150 kilowatt installation at the plant of the Duriron Co., Dayton, O. This is a simple equipment with two furnaces of 600 pounds rating, only one of which operates at a time. The normal charge of 650 pounds is melted in from 1¼ to 1½ hours. The motor generator set is located in the small room back of the switchboards. Although both furnaces are rated 600 pounds in capacity, nevertheless smaller heats down to 250-300 pounds can be made, and this company on occasions has been able to arrange both furnaces so that they were ready to pour at the same time so that from 1200 to 1300 pounds of metal could be tapped. The Duriron Co. produces exclusively corrosion and heat resisting castings and equipment.

Offer Safety Service

Safety work of several thousand industrial members of the National Safety council representing all industries, recently has been analyzed and the most effective technique will be made available to any plant regardless of membership in the council. The only requirement on the part of the company is the supplying of a few essential facts from which the council engineers can draw up a practical working plan commensurate with needs and applied to the specific operating problems.

Information may be secured by addressing the National Safety council, 20 North Wacker drive, Chicago.

Book Review

The Book of Metals, by Donald Wilhelm; cloth, 341 pages, 6 x 9¼ inches; published by Harper & Brothers, New York, and supplied by THE FOUNDRY, Cleveland for $4.00 plus 15 cents postage and in Europe by the Penton Publishing Co., Ltd., Caxton House, Westminster, London.

This is indeed an unusual volume, for it represents a popular discussion of the manufacture of various metals in numerous types and forms, prepared by a man who is not in any sense of the word a metallurgist, and yet the material presented is accurate in all of its ramifications. The idea for the book was conceived as an answer to questions asked by the author's two sons, 14 and 16 years of age, and exactness of statement was secured through the assistance of some 35 advisors.

The author has succeeded in giving, with scientific accuracy, the history, mining, alloying and shaping of metals, phrased in language understandable by those with no previous knowledge of the subject. Iron, wrought iron, cast iron, steel alloys, aluminum, copper, brass, bronze, nickel, zinc, lead, tin, gold, silver and platinum are treated from point of view of process, fabrication and applications.

With the possible exception of the steel foundry industry, all branches of casting manufacture are represented more or less briefly in this volume. A long chapter is devoted to gray cast iron and malleable cast iron; the material for that section having been written with the co-operation of and checked by the American Foundrymen's association, the Gray Iron institute, the Malleable Iron Research institute and Enrique Touceda. The chapter on cast iron includes historical information, a discussion of the manufacture of cast iron pipe, centrifugal casting, gray cast iron, white cast iron and malleable cast iron.

This book will provide interesting and enjoyable reading to any interested in metals.

The sixth annual outing for the Philadelphia Foundrymen's association was held at the Northeast Shrine club, Huntingdon Pike and Fillmore street, Fox Chase, Philadelphia, on June 8. William S. Blessing, Moore & White Co., Philadelphia, was in charge of arrangements.

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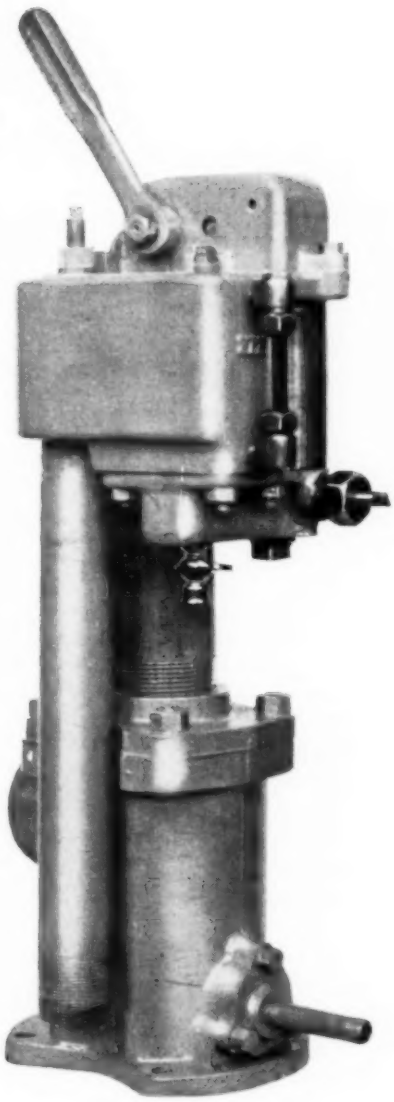

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Refining Methods for Gray Iron

(*Concluded from page 23*)

temperature, as indicated by a slight drop in temperature occurring if none is used.

Results show that this system of melting with the use of the flux in the cupola to thin the slag gives some deoxidation of iron. This, together with the advantages of the forehearth even without the use of fused soda ash on the metal in the hearth, showed improved machinability.

Results obtained on castings from the 60-inch unit are derived from use of both the forehearth and fused soda ash. The following advantages are cited: Permits use of more scrap without sacrificing quality; sulphur content of iron reduced 30 per cent in face of increase in percentage of scrap iron and steel in mixtures; fluidity of slag increased with an increase in fluidity of metal; cleaner metal which pours nicely, due partly to refining with fused soda ash and partly to the fact that forehearth is tapped at bottom; improves toolability.

When the flux is used in the cupola, it may be pointed out that the slag is more fluid, which keeps the coke bed open and aids melting. It also glazes the cupola lining and protects it from scouring action.

It is the practice of that foundry to apply the following test as an indication of the relative machinability of castings of different analyses: A drill test is made on a 1-inch cast bar with a drill running at uniform speed and weighted with a constant load. Drill is sharpened in a jig to assure uniform cutting edge angle. While that test may not conform to a universal standard it gives a reliable test of the relative properties of samples tested by that foundry. Results of the tests are shown in the following:

Time Required to Drill Through a 1-Inch Bar

	Seconds
Metal poured direct from cupola	30
Metal from forehearth (not treated)	28
Metal treated with fused soda ash in forehearth	23

Forehearth and fused soda ash treated metal contained higher percentage of scrap than cupola metal.

Improvement in Machinability

	Per cent
By use of forehearth alone	6.7
By use of fused soda ash in forehearth	23.3

While in experiments that foundry has reduced the sulphur to as low as 0.04 per cent, a content of 0.07 per cent, keeps machining speed at a constant rate satisfactory for production with a minimum of tool grinding so it is used as a standard.

For a production type machine shop the increase of 23.3 per cent in drilling speed, as evident from the test, would effect considerable economies in time and tool expense in a year.

Table I shows direct costs per ton of metal based on operation of the 60-inch cupola. Prices shown are for 1927, when the operation was started, and for 1932. Fixed charges on the forehearth include depreciation, interest and relining costs. Under normal conditions a lining is good for 10 weeks of pouring operation on the basis of 2 to 4 hour heats per day for 5 days a week. Daily cleaning and bottom lining require two hours time for one man.

Consumption of fused soda ash over a period of time is less than at the start of using it. This is due to the fact that after a short time the sprues, spills and returns make up an appreciable percentage of the current mix, which is thereby already reduced in sulphur content by previous refining.

Table I

Comparison of Direct Metal Costs per Ton of Iron

	Cupola Direct		Forehearth and Fused Soda Ash	
	1927	1932	1927	1932
Pig iron—1000 and 700 pounds @ $24 per gross ton	$10.71	.....	$ 7.50	.....
*Same @ $20.04 per gross ton	.....	$ 8.95	.....	$ 6.26
Foreign cast scrap, steel and returns 1000 and 1300 pounds @ $16/ton	7.14	.....	9.28	.....
1000 and 1300 pounds @ $9/ton	.....	4.02	.....	5.22
Limestone—60 pounds @ $3.65/ton	.11	.....	.11	.....
60 pounds @ $3.30/ton	.....	.10	.....	.10
Coke—267 pounds @ $11 per ton	1.47	.....	1.47	.....
267 pounds @ $10.50 per ton	.....	1.39	.....	1.39
Fused soda ash—1 pig per charge @ $.035 per pound	.07	.07	.07	.07
Total direct cupola costs	$19.50	$14.53	$18.43	$13.04
(Cupola expense same for both methods so not included)				
Forehearth expense				
Fixed charges including relining	.....	.....	$ .02	$ .02
Daily labor cost for cleaning, etc.	.....	.....	.03	.03
Fused soda ash—2 pigs per ton metal @ $.035 per pound	.....	.....	.14	.14
Total direct metal cost as poured to ladle	$19.50	$14.53	$18.62	$13.23

*1.75-2.25 Silicon Buffalo basis Feb. 4, 1932.

Offer Opportunity To Industry's Younger Men

Summarizing the year's activities at the June 7 meeting of the Malleable club, Milwaukee, President Scott MacKay stressed the fact that each regular feature of the meetings throughout the year had been designed to aid the younger men of the industry in accumulating experience from those who had been connected with the industry a longer time. He pointed out that ample opportunity for discussion and for questions regarding operating problems always had been afforded and that the support of the membership had been indicated in a gratifying way by faithful attendance.

E. M. Handley, Chain Belt Co., Milwaukee, presented the technical news report and led the discussion which followed. N. Jolman, Belle City Malleable, Racine, Wis., and M. W. Gleisner, Walker Mfg. Co., Racine, contributed considerable interesting information on the subject of "Melting Practice," D. I. Dobson, Glancy Malleable Corp., Waukesha, led the discussion of the "Estimates from Blue Print." M. A. Harder and M. W. Gleisner were appointed to arrange for the summer picnic of the club.

Creep of Metals Measured with Accuracy

Creep of metal, a continuous but almost imperceptible change in size or shape which occurs in a supposedly solid material, has been measured by the University of Michigan department of engineering research with special instruments giving continuous readings accurate to one-millionth of an inch. Results of the research are expected to be of fundamental importance to many industries.

Clarence P. Harris, Industrial chemist, has moved his office from 522 Fifth avenue to 174 Madison avenue, New York.

Institute of British Foundrymen

(*Concluded from Page* 21)

that paper is presented on page of this issue. The discussion was open by C. H. Kain, who said that the price per ton quoted for the duplex process with the use of the electric furnace was high, and would render such an operation noncommercial in Great Britain. He noticed also that the silicon content is higher, and the combined carbon lower, in America than in Great Britain. He found it difficult to account for the hardness obtained with such a low combined carbon. With reference to the question of superheating, he said that this operation is associated with a ferrite structure, therefore tending to reduce hardness, and with inverted chill. He also said that the addition of ferromanganese-silicon absorbs a great deal of heat, and recommended the use of calcium silicide, which gives an exothermic reaction.

J. G. Pearce, British Cast Iron Research association, referred to the method used by the author as being an innoculation process. Owing to the many differences between American and British practice, he suggested that comparable tests, on American and British test bars, should be made in Great Britain as well as in America. F. K. Neath said that with a low carbon, the precision of the silicon contents lost some of its importance. The differences in tensile strength indicated in the paper seemed to be independent of the composition, and were probably due to the distribution of graphite.

Heat Treating Iron

A paper by J. E. Hurst on "Hardening Cast-Iron" embodies considerable work in the plant and laboratories of the Sheepbridge Stokes Centrifugal Castings Co., Ltd. It describes various methods that can now be used to harden cast iron by heat treatment and by nitrogen. Many questions were put to the author, particularly with regard to the effect of additions. He stated that replies in such cases cannot be made by analogy with steel practice, and that many points still remain to be investigated by experiments. F. Hudson cited a case in connection with the manufacture of marine valves, in which methods recommended by Mr. Hurst had been applied with marked success. In replying to the discussion, Mr. Hurst said that it sometimes does occur that a casting cracks during the hardening process. The tempering is done in a salt bath, and the castings are allowed to cool quietly in the air.

"Contraction, Distortion and Camber in Gray Iron Castings" was an interesting paper presented by E. Longden. The author has made a special study of the subject of camber and has worked out a camber chart, showing the camber required for the heavier type of castings, for different lengths and thicknesses. The various factors influencing volume changes are discussed and illustrated by examples. Many points of detail, from a practical angle, were raised in the discussion that followed.

CHARLES E. WILLIAMS, senior vice president, Institute of British Foundrymen, was born in 1866. He was educated at Manor House school, Clapham, London, the Leys school, Cambridge, and the South Wales University college. In 1884 Mr. Williams joined the firm of John Williams & Sons, and he became manager of the Globe Foundry & Engineering Works, Cardiff, in 1887. The Globe foundry was incorporated with John Williams & Sons (Cardiff), Ltd., on the formation of that company in 1899, and still forms an important part of that ompany's activities. Mr. Williams is chairman of John Williams & Sons (Cardiff), Ltd., of Williams (Barry), Ltd., and of Emery Brothers, Ltd., Birmingham. He is director of the Principality Building society, Cardiff, and honorary treasurer of the Blind institute, Cardiff. He was president of the Cardiff & District Master Ironfounders' association for 22 years.

A paper by F. J. Hemming entitled "Some Lifting Considerations in a Jobbing Steel Foundry," draws attention to the large amount of lifting work which a steel founder has to perform, and presents suggestions as to how to meet the problem. J. W. Gardom presented the first report of the subcommittee on malleable cast iron, appointed by the technical committee of the institute.

During the conference a number of visitis were paid to interesting works in and around Newcastle. The annual banquet took place on Wednesday, June 8, and on the Thursday evening a civic reception and dance were offered by the Lord Mayor and Lady Mayoress.

Zinc Die Castings Employed for Clock Parts

Rapid increase in the use of zinc die castings for cases and working parts of clocks has been noted recently by *Daily Metal Trade*. Marked economies in manufacturing costs, especially in large quantity production are bringing larger numbers of zinc die-cast cases into the market in place of metal stampings, wood, and plastic composition materials. Both spring-wind and electric clocks are equipped with the die-cast cases.

Trend toward die castings developed about two years ago when the first clock, a spring-wind type, was introduced to the public with a zinc die cast case. Prior to that time, the zinc die castings were used only for bases on which clocks rested. A year and a half ago, the first electric clock was placed on the market with a zinc die cast case. Since that time, use of the new case form has increased rapidly until now practically every major manufacturer of electric clocks is turning out products of that kind.

Manufacturers of clocks state that the zinc die-cast case, perfected through the use of high grade metal of extreme purity, eliminates the necessity of grinding and polishing to obtain finished surfaces in most instances and thus effects a saving in production cost. The surfaces of the outside walls are readily subject to plating of every other plating metal as well as lacquer finishes. The size of the die castings is unrestricted and are thereby suitable for all styles and designs of clocks.

The use of zinc die castings is not being restricted to clock shells and bases. Such working parts as gears and pinions, as well as gear cases and clock backs, are being made in the die-cast form in place of the machined parts formerly used.

The automotive industry is making greater use of zinc die castings as well as the clock industry, according to fabricators.

R. E. W. Harrison has resigned the sales engineering directory, Cincinnati Milling Machine and Cincinnati Grinders Inc.

High Test Cast Iron

(*Concluded from Page* 13)

from a cupola. Here, also, the grade of iron produced is dependent upon the demand, as iron of practically any composition may be made in this manner. In fact, both the electric furnace and air furnace readily lend themselves to the production of low carbon iron and low carbon is the prime requisite of high test iron.

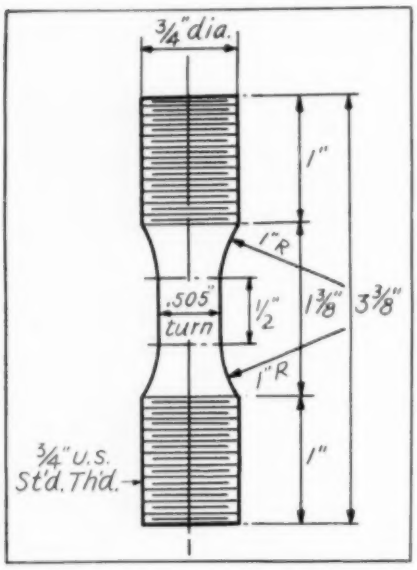


Fig. 4—Tensile specimens were machined from broken transverse bars to the dimensions shown

Some air furnaces previously used for malleable iron castings, now convert excess capacity to high test iron.

Three Main Processes

At least three methods of procedure are now in operation.

1. Making up the entire heat of a composition suitable for gray iron castings of high strength.
2. Adding ferrosilicon or other graphiters in the ladle to part of a regular heat of malleable iron. The remainder of the heat may be used for regular malleable iron castings if desired.
3. Making the heat of hard iron somewhat of the same composition as used for malleable and then heat treating all castings. In this procedure the castings usually are small and the carbon as cast is combined.

Tensile strengths of 60,000 to 110,000 pounds per square inch may be so obtained with various elongations up to 15 per cent depending on the heat treatment. From the many such treatments in use only two will be described.

Fig. 2 shows irons where the castings and test bars were heated to 1700 degrees Fahr. and held at this temperature for 20 hours, then cooled in air, reheated to just below the critical temperature and held 20 hours, then cooled in air. A shorter hold would mean a higher strength with less ductility but with a 20 hour hold, the desired results were obtained. The spheroidization of the cementite should be noted. The view at 2000 diameters was taken between carbon spots which appear in field as in malleable iron.

The analysis of this iron was:

	Per Cent
Carbon	2.29
Silicon	1.11
Sulphur	0.089
Phosphorus	0.18
Manganese	0.85

The physical properties were as follows:

Tensile Strength—lbs. per sq. in.	75,000
Elongation in 2 inches, per cent	14
Reduction in area, per cent	18
Brinell hardness	179
Rockwell hardness	B90

The photomicrographs of Fig. 3 were from an iron where the test bar was held at 1700 degrees Fahr. for eight hours, air quenched, reheated to 1200 degrees Fahr. for 15 minutes, and oil quenched. The analysis of this iron was:

	Per Cent
Carbon	2.34
Silicon	1.37
Sulphur	0.08
Phosphorus	0.18
Manganese	0.37

These samples showed a tensile strength of 107,200 pounds and an elongation of 2½ per cent in 2 inches.

No special alloys were used to obtain the results given. All test bars referred to were A. S. T. M. standard malleable iron test bars cast ⅝-inch diameter round and broken in the rough. In all cases, there was a slight decarburization on the surface. All analyses, hardness tests, and micrographs were taken from center of bar.

Book Review

Science in Action, by Edward R. Weidlein and William A. Hamor; 310 pages, 6 x 9 inches, cloth, published by McGraw-Hill Book Co. Inc., and supplied by THE FOUNDRY, Cleveland, for $3 plus 15 cents postage, and in Europe by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, London.

Development and growth of industry through the application of science is discussed in an interesting manner in this volume. The first section of the book is devoted to a history of industrial research, and the types of laboratories devoted to that purpose. This is followed by facts on scientific research and its effect on the necessities of life, the success which scientific research has achieved in numerous familiar industries, science the pilot of technology, and scientific management and rationalization.

The compilation of facts is arranged to give engineers, scientists and business men a comprehensive picture of the place of science in industry, the need and methods of industrial research, results achieved by various organizations, and important factors in research procedure. The authors are identified with the Mellon Institute of Industrial Research, Pittsburgh.

Experience Speaks

WHEN R. S. MacPherran, chief chemist, Allis Chalmers Mfg. Co., West Allis, Wis., was designated to present the annual exchange paper of the American Foundrymen's association at the 1932 meeting of the Institute of British Foundrymen, a fortunate choice was made. Mr. MacPherran long has been known in America and abroad for the depth and breadth of his experience and information on gray cast iron. His paper, practically in full, is presented in this and the August issue of The Foundry.

Impurities Lower Copper Conductivity

Two of the major impurities which a copper refinery must remove from blister copper are selenium and tellurium, according to S. Skowronski and M. A. Mosher in a paper presented at the April meeting of the American Electrochemical society. Copper selenide and copper telluride are not soluble in the solid solution of copper, and crystallize between the crystal boundaries. Consequently, they have little effect on the electrical conductivity of copper, differing markedly in that respect from arsenic and antimony. That is shown by the following data.

Copper containing no selenium or tellurium had a conductivity of 100.6. Addition of 0.0038 per cent selenium reduced the conductivity to 100.1 while 0.0098 per cent selenium reduced the conductivity to 99.0, and 0.204 per cent selenium lowered the conductivity to 97.5 per cent. The addition of tellurium causes less reduction than with selenium for 0.0104 per cent tellurium lowered the conductivity to 99.9 while the addition of 0.051 per cent reduced the conductivity to 99.4, and copper containing 0.195 per cent tellurium had a conductivity of 99.0.

Stabilize Foundry Costs

Through Accurate Control of Variables

By H. W. DIETERT

THE variable scrap loss in a foundry causes a fluctuation in casting cost that is destructive to all careful cost estimation. The resultant chance to win or lose, has a tendency to cause foundrymen to gamble on their chance of a low scrap loss for a particular lot of castings. This condition does not lead to a profitable and stable industry. Every leading industry is founded upon a productive system that is under control at every point.

However, the foundry can secure a foot-hold in this desirable position, by adopting a measuring device for controlling every operation, similar to that practiced by machine shops, where every part is measured with a tool. Foundry control may be secured by an educational program, which teaches the workman to appreciate exactness. This requires the complete elimination of the present half-hearted chance method.

Co-operation Is Necessary

The heart of every foundry control system is a co-operative group of foremen who know their particular operations, and are capable of convincing the men that their work consists of manual and mental efforts combined. A group of workmen, so controlled, when equipped with proper working and measuring equipment, yield a stable foundry condition which will not destroy the small margin of profit.

The engineer's duty in the foundry control system, is to furnish proper working and control equipment in addition to giving aid in the application of this equipment. Production of machine shops is increased by the aid of measuring, or control tools, and the same will hold true in the foundry.

Gives Methods

IN DETERMINING costs, the results are based on an average and reasonable loss of castings. However, it often happens that the losses exceed expectations, and consequently there is a partial and often total loss of profit. By proper control it is possible to hold the losses within reason and prevent wide fluctuations that are so destructive on profits. This article discussing briefly several methods of control, is abstracted from an address presented at a meeting of the New England Foundrymen's association. The author is associated with Harry W. Dietert Co., and the U. S. Radiator Co., Detroit.

Outlines The Factors

Foundry control should incorporate the following control points:

Purchase of all raw material on a specification that will assure incoming material to be of a uniform quality, so that standardized shop operations need not be adjusted to the variation of raw materials.

Inspection (by applied test methods) of all raw material received to determine definitely, the practical qualities of the material.

Use of raw material in definite weights or volumes to secure a workable material of measured and standardized characteristics.

Treatment of all material in definite routine methods, which are known to produce consistent measured results.

Performance of each production operation to an exactness that is standardized within close tolerance.

Maintenance of equipment to enable reproduction of past standardized performance.

A cost system enabling organization to determine the departmental and total cost of each casting.

A few examples of foundry control will prove beneficial, to show how readily the foundry lends itself to that feature.

A cupola equipped with an iron temperature recorder which has been described by Nyler and Dietert in the Dec. 15, 1925, Jan. 1 and Jan. 15, 1926 issues of THE FOUNDRY, may be operated readily to melt iron at a definite temperature. The value of having molten iron available at a predetermined temperature can not be over estimated.

Study Is Instructive

A study of temperature charts obtained from that device showing the effects of faulty cupola operation, is exceedingly instructive. The most common fault of cupola operation is in the burning or the coke bed. The result of an under-burnt coke causes a low iron temperature at the beginning of the heat. An over-burnt bed will produce the opposite effect, by causing a high iron temperature at beginning of the heat. A correctly burnt coke bed will produce a normal iron temperature at beginning of heat, which may be maintained throughout the heat, providing every operation follows a standardized and correct routine.

Many cupola operators are overly anxious to secure a high iron to

Slag Analyses for Cupola and Ladle

Date	Silica	Lime	Iron Oxide	Alumina Titanic Acid	Manganese Oxide	Magnesium Oxide	Sulphur	Type	Remarks
			Cupola Slag						
6-24	39.25	37.62	4.30	14.63	2.70	1.24	0.60	Basic	
			Ladle Slag						8 Castings show oxidized iron defect
6-24	46.18	2.00	13.90	26.12	7.25	0.43	0.45	Acid	
			Cupola Slag						
6-30	34.80	46.00	3.40	12.12	2.00	0.97	0.82	Basic	
			Ladle Slag						64 Castings show oxidized iron defect
6-30	45.00	0.80	27.00	9.61	10.80	0.34	0.32	Acid	

coke ratio, by reducing the coke too soon on charges near the end of the heat. The result being an insufficient amount of coke to maintain the coke bed at its proper height. That causes iron to be melted in front of the tuyeres, and the iron temperature will suddenly jump to a high range and become oxidized.

A soft coke which burns too rapidly, often causes the coke bed to drop to a dangerously low level. The iron temperature will follow an irregular temperature range, raising to a high temperature every time the charge drops to a low level.

Add Booster Charge

The iron temperature can be changed during a heat, if found necessary by adding a booster coke charge which results in a temperature rise as soon as the additional coke charge reaches the melting zone. An irregular air volume delivered to the cupola causes considerable fluctuation in metal temperature. The same cupola operated with a constant air volume produces metal of constant temperature.

Cupola slag must be of a definite chemical composition to possess maximum purifying power. The quantity of limestone and fluorspar charged into the cupola should be calculated to give a slag of desired composition, producing maximum fluidity, low melting and freezing temperatures.

The color of cupola slag, when slowly cooled, depends upon the iron oxide present. The greater the percentage of iron oxide the darker the slag, as may be noted from the following: Glassy yellow, 0.97 per cent iron oxide; gray stone, 1.23 per cent; dark green, 1.17 per cent, and dull black, 2.33 per cent iron oxide. All chemical constituents of slags given were practically identical, with the exception of the iron oxide content.

A cupola slag containing equal portions of lime (CaO) and silica (SiO) proves to be a satisfactory slag. The fluidity of slags increased with an increase of magnesium oxide content, up to 17 per cent. That makes it possible to reduce quantity of limestone charged when magnesium content is high.

The slag analyses, as tabulated in the accompanying table illustrate further, the importance of slag control. A comparison between the cupola and ladle slag, will show that the cupola slag is basic and ladle slag is acid. That is due to the iron oxide pick up, and to the thoroughness of slag separation from the iron before reaching the ladle.

A comparison of cupola slags for the dates 6-24 and 6-30 given in the table shows wide differences between the ratio of silica to lime content, which affects melting and freezing temperatures of the slag. The ladle slags for these two dates are of particular interest in that the iron oxide content for 6-24 is 13.90 per cent and 27 per cent for date of 6-30. The ladle of iron dated 6-30 contained oxidized iron. A comparison of casting loss for these two dates shows a high loss of 64 castings for 6-30, and a low loss of 8 castings for 6-24.

Providing the iron temperature, slag anlysis and iron analysis are controlled, within practical limits, one knows that all melting operations were performed correctly.

The continual changing of pattern gates, risers and molding methods usually delays the recovery from a high loss epidemic. Experimentation on pattern equipment is only justified when a definite point is to be determined.

Gate size on a pattern should be accurately calculated to make certain that casting will be poured at a predetermined rate. Every foundry will find it highly advantageous to standardize the rate of pouring. The rate of pouring should be measured by the pouring time determined by a stop watch.

When all castings are poured at a classified standardized pouring time then it is unnecessary to make special provisions for any casting. The method of having molder hold back on pouring endeavoring to ease up the pouring speed only leads to more variables resulting in fluctuating losses. That statement is made knowing that personal element always leads to variations, an unprofitable condition so prevalent in foundries.

Gating formulas as advocated by the author are proving practical and profitable in a number of foundries. They furnish a means of standardizing gate sizes so necessary in standardized production methods. Where the coefficient as used in gating formulas does not meet conditions it is not difficult to determine proper coefficients.

Acquires Business Of Engineering Company

Standard Sand & Machine Co., Chicago, has acquired the business of the Carol Engineering Inc., and will operate that company in conjunction with its own. Standard Sand & Machine products now include the sand mullers, as well as sand mixers and continuous roll mixers. S. T. Johnston has been appointed president and W. C. Packard, sales manager.

W. C. Lytle, Evanston, Ill., has terminated his connection with the Pangborn Corp., Hagerstown, Md., with which organization he was active for 16 years, and during the past 10 years was district sales engineer for that firm in Chicago.

Malleable Institute Makes Special Surveys

Three reports on surveys of special subjects, prepared by the Malleable Iron Research Institute, Cleveland, and recently distributed, have attracted unusual interest. One is a complete detailed census as of June 1, of the malleable iron industry, covering plants in active production, plants temporarily closed and plants which have been closed permanently during the past 6 years, together with the aggregate plant capacities of each group with further classifications showing malleable foundries engaged in jobbing work, those engaged in the production of specialties and those operated by companies where the work is largely for their own requirements.

Another report is a pictorial brochure on new malleable uses which contains photographs of over 100 new malleable parts. This report was prepared for members use as illustrative and descriptive of new malleable fields in their respective vicinities which may be awaiting development.

A third report which promises to be of material help to members covers an illustrated accounting procedure whereby members can determine definitely at what point tonnage ceases to be a factor in reducing overhead. A procedure is illustrated whereby each producer can determine a formula, under his own particuular expense set-up, which can be used to determine this most important point. The procedure was developed by Robert E. Belt, secretary of the institute, who has had a wide experience in foundry cost problems.

Consider the X-Ray

Various subcommittees of A. S. T. M. committee E-4 on metallography are engaged in investigational work. One is studying the x-ray and gamma ray testing field. Another is reviewing present standard methods of metallographic testing of iron and steel, and of nonferrous metals and alloys. A third subcommittee is selecting proper combinations of objectives and oculars for various magnifications. C. H. Davis, American Brass Co., Waterbury, Conn., and O. E. Harder, Battelle Memorial institute, Columbus, O., are directing activities of committee E-4.

In New York Office

C. W. Ross, formerly connected with the Philadelphia office of the C. O. Bartlett & Snow Co., Cleveland, has been transferred to the New York office of that company, where he will be associated with W. H. Norrington, New York manager of the eastern territory.

Steel Founding in America

(*Concluded from Page* 25)

Chrome; 3 Chrome-Molybdenum—of varying carbon content and treatment.

High Temperature Service (Scale Resistant): 1. Nickel-Chrome—with varying alloy content up to 65 per cent nickel and 18 per cent chrome, depending on operating conditions; 2. Chrome-Silicon; 3. High Chrome steel.

Corrosion Resisting Steels: 1. Nickel-Chrome, of the 18 and 8 or similar type; 2. Rustless Iron, low carbon high chromium; 3. Stainless Steel, medium carbon high chromium.

While this list does not claim to be in any way complete, it will be seen that American engineers have an adequate field of choice in specifying steel for castings required for special purposes.

There is probably no industry where it is more vital that continuous research inside the industry should be carried out, than that of founding. The number of operations and influences on the basic material used is legion, and the controlling factors of these influences must be understood if success is to be attained.

Research in America has grown with industry, and there exists practically no traditional prejudices to overcome. On all hands, continuous research for better methods for complete control is proceeding. Adaptation of that method of thought into steel founding has been followed by quite rapid development. Investigation into molding sand, as an example, has resulted in the evolving of certain standards, and development of instruments, simple in use, to establish control over sand mixtures so that standards may be maintained.

Melting the Metal

In steel making for castings, careful observation and investigation has demonstrated the necessity for particular care in furnace manipulation, if steel is to withstand the unsettling mold effects. Studies of the response of cast structures to heat treatment have resulted in definite knowledge as to time and temperature in relation to mass of casting. Continuous investigation into solidification conditions has been the means of evolving better methods of gating and feeding.

A combination of these and similar types of research undoubtedly has raised the standard of the steel casting, more particularly from the viewpoint of appearance and internal soundness. A continuation and extension of investigation into the matter of design will be followed by even more marked results.

The question of research into foundry fundamentals is always a live subject for discussion among American foundrymen, and the avowed object of it all is *control;* control of those vagaries to which steel castings were at one time notably liable; control of the expenditure of time and its correct use; control of expended energy to produce a given article; and finally, control of those factors which by their absence or presence definitely define the behavior of the resulting casting in service conditions.

To the European, the American would appear to be a great believer in conferences and discussions. As a business man, he could hardly have developed this belief, did he not believe the expenditure of time to be worth while. The result of this has been a large growth of the association movement, both of commercial and technical type. In both cases, the associations are extremely active, attendances are large, and the programs both ambitious and progressive.

The value of any trade or technical association, and its possibility of growth and activity, is in direct proportion to the degree of interest evinced by the membership, and attendance at a number of association meetings in this country has impressed the author with the possibilities made available by a full and impartial discussion, and an unrestricted interchange of ideas. The feeling of industrial fellowship engendered by these associations shows itself prominently in the willingness evinced by manufacturers to welcome their competitor's representatives at their plant.

It can be said with truth that any accredited representative of a steel foundry will receive a welcome at the plant of his competitor, in this country. It is recognized that one gains equally as much as is given, by such procedure. As a result, the steel casting industry in the United States tends to progress as a whole, to the ultimate benefit of the entire industry, as an outcome of higher standards of attainment.

This is the second and concluding installment of the exchange paper of the A.F.A. to the Australian Bureau of Steel Manufacturers. The first section appeared in the June issue.

THE EDITORS

Presents Thermal Data

Data on the linear thermal expansion of nickel-chromium iron-chromium and nickel-chromium-iron alloys between 20 and 1000 degrees Cent. are presented in research paper No. 388, published by the bureau of standards, Washington. Investigation was conducted by Peter Hidnert, and includes effect of chromium content, carbon content, heat treatment, etc. on coefficients of expansion of alloys for various temperature ranges. Effects of change of composition on coefficients of expansion of both cast and annealed alloys are given. Copies of the paper may be obtained from the superintendent of documents, Washington, for 25 cents.

Campaign Brings Decline in Accidents

Accident frequency in Ohio foundries during April was 41.6 per cent below November 1931, following the close of a 6 month state-wide campaign to reduce accidents. Last November the first month of the campaign, found an average of one accident for each 26,562 man hours worked. The total dropped to 25,763 in December and 25,505 in January. In February the average showed one accident for every 30,307 man hours, in March 41,039 and in April an average of 45,467. For the entire six months, the average was 29,010 man hours per accident, which was 9.12 per cent lower than the frequency rate in November.

Mansfield, O., set the state record with an average of 202,887 man hours per accident. A. H. Kramer, Advance Foundry Co., Dayton, O., president of the Ohio Foundries association, sponsor of the movement, was general chairman, J. W. Beall, Ohio Steel Foundry Co., Lima, O., was assistant general chairman and Robert Hoierman, secretary, Ohio Foundries association, Cleveland, was managing director.

New England Founders Hold Meeting

Edward C. R. Bagley, deputy commissioner of Correction, Commonwealth of Massachusetts, spoke on "Prison Labor" at the regular monthly meeting of the New England Foundrymen's association, held at the Engineers' club, Boston, on June 8.

The July meeting of the association will be omitted and the August meeting will be in the form of an outing at Providence, R. I.

The American Standards association, New York, has published a standard for cast iron pipe flanges and flanged fittings for maximum nonshock working hydraulic pressure of 800 pounds per square inch gage. Copies may be purchased for 35 cents each through the office of the association 29 West Thirty-ninth street.

European Foundry Practice

Digest of recent literature covering various phases of castings manufacture

Wear of Brake Shoes

A Contribution on the Wear of Cast Iron Brake Shoes (Beitraege zur Abnutzung gusseiserner Bremskloetze), by Ernest Scharffenberg, *Die Giesserei*, Duesseldorf, Germany, April 15, 1932.

Investigations carried out by the author indicate that an increase of 30 to 40 per cent in specific wear occurs with a specimen that has been tested as compared with one that is being tested for the first time. It appears that an optimum specific wear is obtained with a definite load, but it was not possible to determine conditions to obtain optimum specific wear. Investigation of relation of chemical composition and wear indicates that pearlitic structures are more resistant. Best results were obtained with a carbon content from 2.7 to 3.0 per cent. Least wear was obtained with 1.5 per cent manganese. The same conditions obtained with 0.75 per cent phosphorus, and high sulphurs ranging from 0.130 to 0.210 per cent. In the case of phosphorus, it should be imbedded in a pearlitic matrix, otherwise the hard phosphide eutectic will be pulled out through rubbing action and act as an abrasive.

Furnace Operation

Annealing Furnace for Malleable Iron, Foundry Trade Journal, London, June 2.

Recuperative type annealing furnace described employs continuous recuperators consisting of specially manufactured hollow fire bricks made with ribs on outside, top and bottom. Bricks are put together to form a number of parallel square flues through which waste gases pass downward on leaving the furnace, and transverse flue through which secondary air passes in extremely thin layers. Secondary air, regulated by slides, is introduced into the lowest of the heating flues and runs alternatively left and right through horizontal transverse flues in an upward direction, finally reaching the combustion chamber through the special flue. Gases of combustion, in consequence of the great surface of extremely thin walls dividing the air from the waste gas flues, are utilized to the utmost, and the secondary air is heated to a corresponding high degree. Furnace can be raised to working temperature within 24 hours, and in considerably less time when the furnace is ready for firing while the air flues still are hot. Time required for annealing depends to a great extent upon the class of castings under treatment.

Protects Scrapers

Handling and Storage of Molding Sand; Metals and Materials that Effectively Resist the Abrasive Action of Sand (Manutention et Emmagasinage du Sable de Fonderie; Metaux et Matieres Resistant Efficacement a l'Action Abrasive du Sable de Fonderie), by J. R. Delin. *Bulletin* of the Association Technique de Fonderie, Paris, April, 1932.

Experiments were made to determine abrasive action of sand on various parts of sand handling machinery. Steel foundry sand containing 91 per cent silicon and 150 grammes of water per kilogram was used in the experiments. For metallic parts exposed to abrasive action of sand, the author recommends nickel-chromium steel, provided the proper heat treatment has been secured. He also emphasizes the protective action of india rubber, particularly for scrapers. Following tests made in the laboratory to determine the best angle for walls of bins and hoppers to secure a satisfactory flow of sand, it was found that the angle should be between 40 and 50 degrees.

Bearings Tested

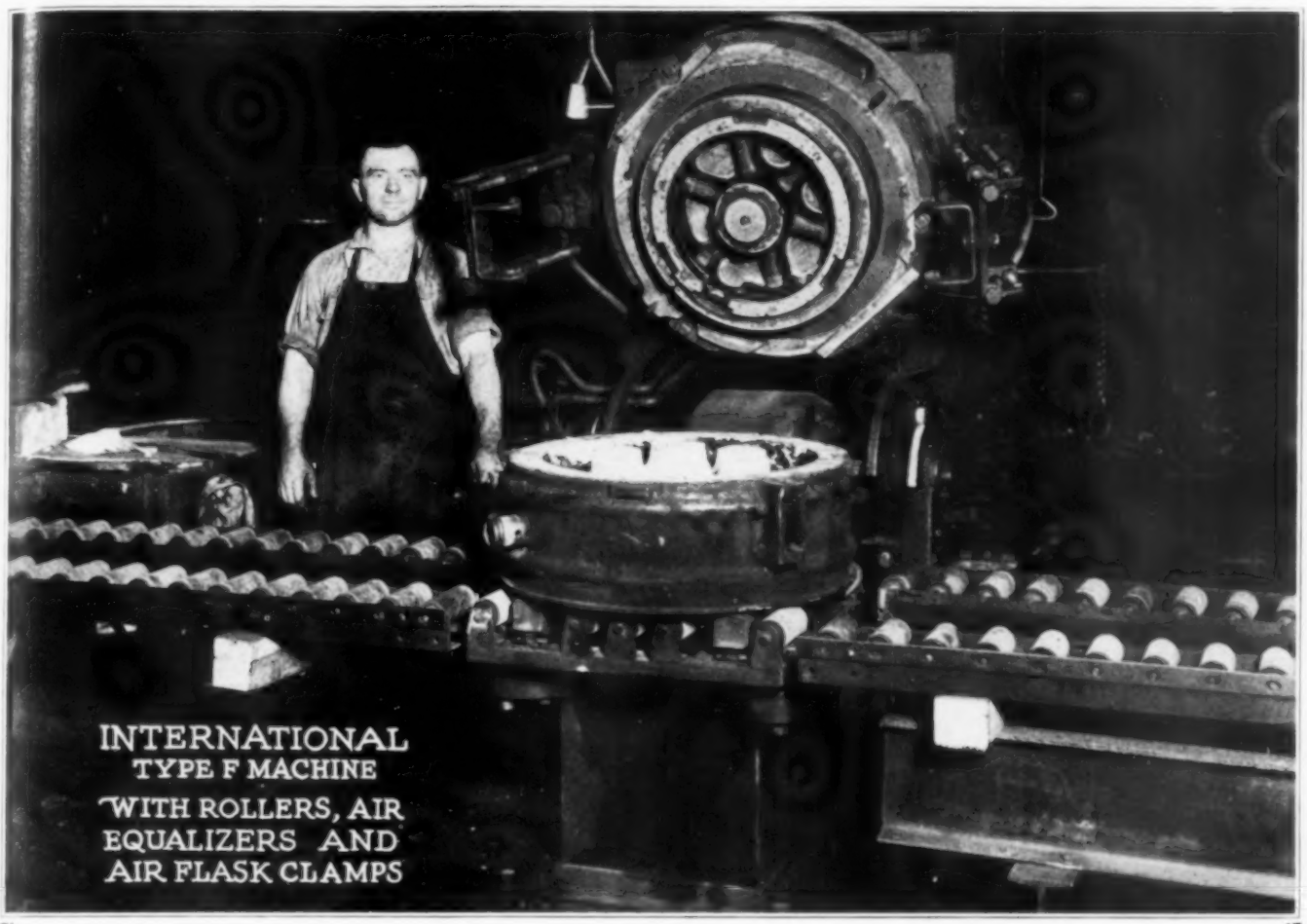
Study of the Composition of a Rolling Mill Bearing, (Etude de la Composition d'un Coussinet de Laminoir), by G. Antoine, *La Fonderie Belge*, Liege, Belgium, February, 1932.

Tests were made on alloys for rolling mill bearings to ascertain influence of alloy composition and pouring temperature. Actual test principally was the period bearings were in service, and a few tests were made for resilience, brinell hardness and microscopic examination. Alloys used all had a copper and tin base, with additions of zinc, lead, nickel and phosphorus. Most satisfactory results were obtained with composition of: Copper 85.5 per cent; tin, 9 per cent; lead, 4.5 per cent; nickel, 0.2 per cent; zinc, 0.5 per cent; phosphorus, 0.25 per cent. Phosphorus has considerable influence on the time during which bearings can be used in service. Most favorable amount of phosphorus ranges between 0.2 and 0.3 per cent. Increase in tin to 12 or 13 per cent is unfavorable, slightly decreasing wear, but increasing resilience, with the result that the bearings are likely to break. An increase in content of nickel is unfavorable, rapidly increasing hardness of the bearing, with a resulting tendency to break. Pouring temperature influences properties of the alloy, and it has been generally found that the properties of the bearing are most favorable when the pouring temperature is high.

Loam Molding

Loam Molding for Oval Castings (Le Troussage de Moules Ovales), by M. Delcroisette, *La Revue de Fonderie Moderne*, Paris, France, Jan. 25, 1932.

Molds for oval castings such as slag ladles are prepared by a device operating on the mathematical principle of the ellipsograph. Strickel board construction is as follows: A cross beam complete with two slots at right angles is fixed on a vertical axis. The strickle board is located on the extremity of an arm under which two rollers are attached. This arm first is placed along the direction of the long axis of the eclipse, and one roller is placed exactly in the center. The other roller is fixed at a distance equal to the difference of the radii of the circumscribed and inscribed circles of the ellipse. The strickle is attached to the arm so that its edge is at a distance equal to the radius of the circumscribed circumference. By revolving the strickel board, the two fixed rollers must travel along the slots at right angles, and the edge of the strickle board describes the required ellipse.



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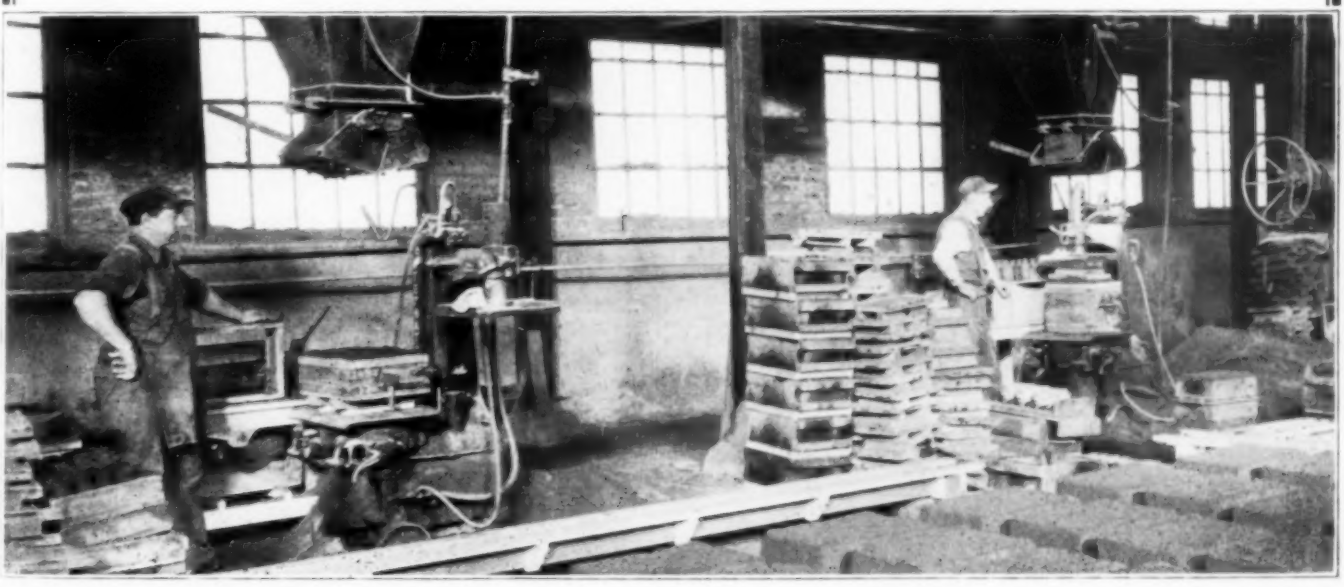

Engineers Study Castings

(*Continued from page* 17)

foundry origin. All can be corrected. A tabular comparison of properties of a wide range of these special steels was given.

Norman Pilling, International Nickel Co., Bayonne, N. J., stated that in corrosion resistant steels, the practical application to meet commercial needs has gone ahead of laboratory study. The proper relationship between nickel, iron and chromium is important in choosing the proper alloy for certain requirements.

Customers Cranky on Alloys

A written discussion by A. C. Jones, Lebanon Steel Foundry, Lebanon, Pa., stated that too many special analyses are requested by customers. Consultation with the foundry often will serve the interests of buyers best. The alloy of 18 chromium, 12 nickel, sometimes specified in low carbon will prove better in actual foundry production if the carbon content is slightly increased.

J. T. Mackenzie, American Cast Iron Pipe Co., Birmingham, Ala., cited the use of 7 per cent chromium iron castings, changed to 18 chromium with 8 nickel and afterwards to 28 chromium, 18 nickel, applied in the upper portion of a cupola lining. All had warped under repeated heating and quick cooling.

The oldest alloy steel, austenitic or Hadfield's manganese steel was described in detail by John Howe Hall. This metal which carries the manganese content up to 10 to 14 per cent gives strength, toughness and great resistance to wear. No difference in quality is found through the employment of either electric furnace or converter melting practice. The material as cast is brittle until heated to somewhat over 1000 degrees Cent. and quenched in cold water. It gains in toughness under cold working and accordingly is valuable for use in rock crushers, frogs, crossings, ball-mill plates and similar service. Quite recently welding rods have been developed which permit welding high manganese steel. By the use of a special welding rod for the manganese casting and another type for rolled steel, welds can be effected between the austenitic manganese casting and structural materials. This permits welding on switch points.

Those special heat treatments required by various classes of steel castings were covered in a paper by A. W. Lorenz, Bucyrus-Erie Co., Milwaukee.

A paper by T. S. Quinn, Lebanon Steel Foundry, Lebanon, Pa., was abstracted by Major Bull. Mr. Quinn states that the steel casting industry in general has benefitted by the recent development of fusion welding. Improvements in casting design is one marked benefit. Many economies resulting from welding fabrication might have been attained more readily in an all-cast product if foundrymen had been permitted to simplify the design of the original casting so as to make it as cheaply as possible without sacrificing any desireable property or useful construction feature. The novelty of the welding process has been a factor in its favor. Test data on welded cast steel are given and numerous examples of combined cast and wrought construction are offered.

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PRESENTATION of proposed tentative specifications for gray iron castings, by committee A-3, under chairmanship of Hyman Bornstein, Deere & Co., Moline, Ill., marked a long step forward for the gray iron branch of the foundry industry. These specifications, which offer revisions and will supersede present A. S. T. M. standard specifications for gray iron castings and also those relating to so-called, high-test, cast iron involve many new departures. Acknowledgement was made by the committee to the Gray Iron institute for its co-operation in development.

Seven classes of gray iron castings are listed and designated, running from 20,000 to 60,000 pounds per square inch tensile strength. Transverse tests are provided, as optional and provide for three round bars, 0.875, 1.2 and 2.0 inches in diameter, which are to be tested upon span lengths of 12, 18 and 24 inches respectively. Proportionate requirements for minimum breaking loads at the center are provided, in accordance with the various classifications. Both tension and transverse bars are cast separately from the castings.

Proportionate Bars

On agreement between manufacturer and purchaser, the three diameters of transverse test bars are provided to represent various casting sections as follows:

Test Bar	Controlling section of casting (In)	Nominal diameter of test bar as cast (In)
A	0.75	0.875
B	0.75 to 1.10	1.20
C	1.11 to 2.00	2.00

A table of correction factors for variation from these diameters is supplied. Three corresponding sizes of tension test specimens also are provided as shown in the accompanying Fig. 1.

Various requirements as to workmanship, finish, inspection and other factors are included and at the request of the buyer, the manufacturer is obligated to certify his product to conform to the requirements of the specifications. Chemical content is subordinated to physical properties, except upon individual agreement.

The committee also presented new tentative specifications for cast-iron culvert pipe divided into standard, heavy and extra-heavy classifications. Tests are provided upon the actual castings.

The mechanism of deformations in gray iron and a new theory on the phenomena of permanent set, were outlined in a paper by J. W. Bolton, Lunkenheimer Co., Cincinnati, gray iron foundry advisor to THE FOUNDRY. Stress distribution in gray iron is not uniform and paths of

greatest stress intensity usually lie between graphite flakes closely approaching each other and where position in relation to the directional line of stress is unfavorable. Resistance is lessened with greater amounts, large size and unfavorably distributed flakes, and permanent deformation is aided. Compacting graphite flakes between adjacent matrix probably takes place at lower deformations, but overstressed paths increase with heavier loads. While resistance to permanent deformation varies inversely with the amount of graphite, if size and distribution of particles are constant, it depends more directly upon the amount, size and distribution of graphite and nature of the matrix rather than upon amount of graphite present. The influence of the shape of graphite was noted in the discussion of A. H. Dierker, Ohio State university, Columbus, O., who remarked upon the absence of apparent set in malleable iron.

C. L. Clark, University of Michigan, Ann Arbor, Mich., presented a paper of which he was joint author with A. E. White of the same institution, on the influence of recrystallation temperature and grain size on creep characteristics of nonferrous alloys.

New Malleable Specifications

NEW proposed tentative specifications presented on behalf of the malleable committee by E. K. Smith, Electrometallurgical Sales Corp., Chicago, were offered to cover castings for railway, motor vehicle, agricultural machinery and general purpose machinery uses. These offer two grades with tensile strength requirements of 50,000 and 53,000 pounds per square inch, respectively and elongation of 10 and 18 per cent in 2 inches.

An era of scientific achievement is unfolding and the next ten years will see new discoveries, rapid development in utilization and service of new inventions was predicted by Dr. F. O. Clements, technical director, General Motors Corp., Detroit, in the annual presidential address. Industrial vision is being corrected by present conditions and in a few years we will engage in projects not even known today.

Many of these point to greater futures for metal industries and new alloys are coming fast to meet the need for change. The speaker praised standardization as a servant, and recommended its application to materials and processes, but warned against its application to mental characteristics. A continued search for new knowledge is the need of the present.

A number of important committee reports were presented. John Howe Hall, Taylor-Wharton Iron & Steel Co., Highbridge, N. J., reporting for committee A-4 of which H. M. Boylston, Case School of Applied Science, Cleveland, is chairman noted new terms submitted in the nomenclature of heat treatment of iron and steel.

Proposed tentative specifications for ferrotungsten, low carbon ferromolybdenum and for molybdenum salts and compounds were approved on recommendation of the committee of which N. B. Hoffman, Colonial Steel Co., Pittsburgh, is chairman.

Due to the fact that little basic bessemer steel is manufactured in the United States, since raw materials are not suitable for its manufacture, committee A-1 on steel, for which J. B. Young, Reading Co., Philadelphia reported as chairman recommended important changes in standard and tentative specifications for structural steel. At a meeting of this committee, H. H. Morgan, Robert W. Hunt Co., Chicago, was chosen chairman to succeed Mr. Young.

Jerome Strauss, Vanadium Corp. of America, Bridgeville, Pa. in presenting his report as chairman of the committee on iron-chromium and related alloys stated that a discontinuance of trade names and classification according to alloy content is suggested.

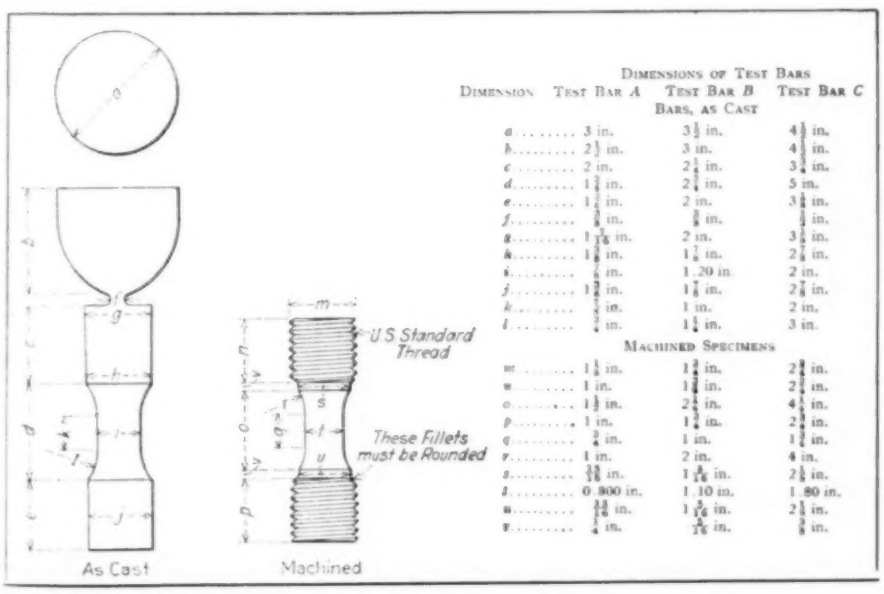
The subject of magnetic properties in relation to nondestructive testing was covered in a committee report presented by R. L. Sandford, bureau of standards, Washington, and in a paper of which Mr. Sandford was co-author with J. V. Emmons, Cleveland Twist Drill Co., Cleveland. A complete revision of standard methods of test for magnetic properties is proposed as tentative by the committee.

The paper reported the attempt to correlate mechanical and magnetic properties of 1.21 per cent carbon tool steel. The conclusion drawn is that each property has its own individuality which is distinct from all other properties, and that when a relationship is apparent between magnetic and mechanical properties it is only for a limited range of heat treatment. This should not be interpreted as detrimental to the value of magnetic tests or analysis. It affords an inspection method capable of application.

The report of the research committee on fatigue of metals, under chairmanship of Prof. H. F. Moore, covered a summary of existing knowledge on fatigue phenomena in metals, and the significance and limitations of test results were explained. Fatigue failures are common in machine parts, rare in structures and pressure vessels take an intermediate classification in susceptibility. The term fatigue of metals is designated to refer only to actual failures of metal parts by a spreading crack.

Study Nonferrous Corrosion

Two sessions of The A. S. T. M. annual meeting were devoted to properties and tests of nonferrous metals. The committee on corrosion of nonferrous metals and alloys proceeding in the study of laboratory,



Dimension	Test Bar A	Test Bar B	Test Bar C
	Dimensions of Test Bars		
	Bars, as Cast		
a	3 in.	3½ in.	4½ in.
b	2½ in.	3 in.	4 in.
c	2 in.	2¼ in.	3¼ in.
d	1¾ in.	2¼ in.	5 in.
e	1¼ in.	2 in.	3½ in.
f	⅝ in.	⅞ in.	1 in.
g	1 1/16 in.	2 in.	3½ in.
h	1¾ in.	1⅞ in.	2⅞ in.
i	¼ in.	1.20 in.	2 in.
j	1½ in.	1¼ in.	2⅞ in.
k	½ in.	1 in.	2 in.
l	¾ in.	1¼ in.	3 in.
	Machined Specimens		
m	1¼ in.	1¼ in.	2½ in.
n	1 in.	1¼ in.	2¼ in.
o	1½ in.	2½ in.	4½ in.
p	1 in.	1¼ in.	2¾ in.
q	¾ in.	1 in.	1½ in.
r	1 in.	2 in.	4 in.
s	3/16 in.	1 1/16 in.	2⅛ in.
t	0.800 in.	1.10 in.	1.80 in.
u	11/16 in.	1 5/16 in.	2¼ in.
v	¼ in.	5/16 in.	⅜ in.

Design and dimensions of tensile strength test bars for gray iron

accelerated tests has developed standards of practice covering preparation of samples, total immersion, alternate-immersion, salt spray and electrolytic methods in relation to this study.

Numerous changes in the tentative specifications for copper-base alloys, cast and wrought were offered as a result of a year's experience. Typical of these changes, which in the main are small is the increase of zinc chemical composition of Alloy No. 16 for sand casting, from 0.25 to 0.50 per cent. The alloy of copper 80, tin 10, lead 10 per cent permits the inclusion of 0.03 per cent silicon and no aluminum. New proposed tentative specifications for copper water tube were offered by the committee.

In a paper on cast red brass, copper, 85, zinc, 5, tin, 5 and lead, 5 per cent by H. B. Gardner and C. M. Saeger, Jr., bureau of standards, Washington, using separately cast bars, comparison is made of pouring temperatures and of sand and chill cast ingot and remelt mixtures. The pouring temperature has a marked influence upon sand-cast bars and the best physical properties were obtained from test bars poured at 2000 to 2100 degrees Fahr. Somewhat better running results were obtained with remelt metal cast in green sand than with virgin metal cast under the same conditions. Shrinkage properties also are given.

The committee on die cast metals and alloys of which H. A. Anderson, Western Electric Co., Chicago, is chairman recommends a zinc of 99.99 per cent purity for production of zinc base die castings. The study of aluminum base die castings for corrosion resistance is in progress with specimens exposed throughout the country.

A study of mechanical properties of white metal bearing alloys at different temperatures, reported in a paper by H. K. Herschman and J. L. Basil, bureau of standards, Washington, show that tin-base bearing alloys show a lower wear rate at 68 degrees Fahr. and in most cases higher impact resistance at higher temperatures, but lower resistance to pounding at higher temperatures. An alkaline metal hardened lead and cadmium-zinc alloys have greater hardness and resistance to deformation under pounding and better compression properties at temperatures up to 390 degrees Fahr.

Trade Association Exerts Powerful Influence for Prosperity

TRADE associations occupy a very definite place in American economic structure according to D. D. Stewart, the Ben Franklin club, Seattle, speaking recently before the Washington Foundrymen's club. In times of prosperity they perform a useful function and, if well managed, produce highly desirable results. In times of economic stress, such as we are now passing through, their existence and functions become almost a vital necessity. A trade association, when properly conducted, will render a powerful influence in regaining and sustaining prosperity. Detailed operations of associations in various lines of business may, of necessity, vary; but the basic principle would probably remain very similar.

There are three major functions of a trade association. First and foremost is the creation and administration of a practical code of ethics or business conduct in competition. This means that business men are restrained by rule and by custom from using unfair and destructive competitive tactics. It is a recognized fact that the prosperity of any business is measured largely by the prosperity of its competitors; but men need to be constantly reminded that they cannot build themselves up by tearing their competitors down.

The second major function, and it is closely allied with the first, is the prevention of undue interference with established business. Of course no association can recognize customer ownership. Neither should an association attempt to stifle competition. At the same time competitive methods that tend to destroy confidence or the harmonious relationship which may exist between a producer and a consumer is uneconomic, wasteful, and destructive. If a producer is supplying the requirements of his customer with satisfactory service, honest merchandise, at a fair and reasonable price, there is no sound reason why a competitor should step in and use the price appeal as a means of breaking up that relationship.

The third major function is to provide equipment or machinery to do those things for an industry which an individual would find it difficult or impossible to do alone, such as the establishment and maintenance of a technical department to carry on research work; to disseminate information regarding cost systems; statistical information regarding advancement of process methods; to take cognizance of, or action upon, matters of legislation or public policies.

A trade association, if it is to function efficiently and deliver valuable service in proportion to its cost of maintenance, must be organized and maintained exactly as a business is organized and maintained. A corporation might be well financed, have a sizeable group of stockholders, a competent board of directors; but it would falter and fail almost before it got started if it lacked competent management and adequate facilities. The same thing is true of a trade association.

It takes more than membership, elected officers, and appointed committees. It must be a real business institution equipped to function every day in the year. It is all right for a trade association to hold meetings once or twice a month and determine upon general policies, but this is not enough. Working facilities must be setup and placed in charge of a competent staff so that every member will feel that the association is running parallel with his business routine and that its facilities are available to him at all times and actually become a part of his own business structure. This costs money but it is about the best type of business insurance known.

Studies Gas Heating

A recent publication of the engineering experiment station, Purdue university, Lafayette, Ind., is entitled "Development of a Direct Contact Water Heater" and represents the work of L. A. Scipio, dean of engineering, Robert college, Constantinople, Turkey. The report represents a study on equipment utilizing gas as a fuel for heating purposes, which provides a means of mixing the burned gases directly with the water to be heated. The bulletin may be obtained from the university for 35 cents.

Testing with Gamma Rays

Institute of research, Lehigh university, Bethlehem, Pa., recently published a bulletin entitled "Gamma Ray Testing of Welds," by G. E. Doan, describing use of gamma rays emanating from radium for penetration of welds and steel castings up to 7 inches in thickness. The method is supplemental to and an extension of X-ray testing. The radium is portable, and permits the examination of a large number of test objects simultaneously without the installation of electrical equipment. The bulletin is 10 cents.

Dr. Edwin Fitch Northrup, vice president and technical advisor, Ajax Electrothermic Corp., Trenton, N. J., was awarded the honorary degree of doctor of science by the University of Lehigh, June 14.

Castings Resist Corrosion

(*Concluded from Page* 15)

any dirt before it entered the mold. The casting in the immediate foreground was gated at one side near the end.

Castings similar to that shown supported by the man in the illustration are set in concrete and the long prongs shown serve to hold the casting in place. These angle castings are molded two in a flask with one side flat in the drag and the other side extending down into the drag. That part of the pattern lying flat is provided with a number of holes corresponding to the number and location of the prongs required.

After the cope has been removed a round stick the proper diameter, is pushed down through each hole in the pattern and into the sand a certain distance marked on the stick.

Castings of the same contour but of longer length were molded in practically the same manner. However, because of the flask equipment available, if only two were molded in the flask, much waste space would remain. A casting of the type shown third from the left standing in Fig. 5, was placed in the mold between the longer castings. The mold was poured from both ends and gated in a manner that filled the three castings simultaneously. The sprue at each end was located midway between the two longer castings and the longest section of the gate extended to the smaller casting in the middle. Branches were cut to the longer castings from the main gate. This method produced good castings.

Employ Skim Gates

The alloy used in these castings tends to become drossy and must be introduced into the mold with the least disturbance. Skim gates are used to prevent dross from entering the casting cavity. Set gates are used wherever possible, thus reducing the amount of gate cutting to a minimum. The value of set gates is well known and has been referred to in several of the series of articles appearing in THE FOUNDRY during the past year, entitled "Prevent Losses with Proper Gates and Risers."

With the alloy under discussion, the size of the gates generally is the same as would be used on similar castings in bronze. The sand falls from the castings readily and hence reduces the cleaning required.

The cleaning, finishing and shipping room located directly in the rear of the melting department, contains a special section for metal storage. Gates are removed from the larger castings on a metal cutting saw provided for that purpose and the smaller gates are cut from the castings on a sprue cutter. A specially designed sandblast is available for cleaning castings where that operation is required. Grinders and other machines are available for the proper finishing of the class of castings made by the Paulson company.

At the time data were secured for this article, effort in the foundry was concentrated on sewage treatment equipment castings of the special design illustrated. However, the scope of the company's activity takes in a wide range and includes the production of castings from practically all nonferrous metals. The accompanying illustrations show a few of the many types of castings produced.

High Lighting Finish Applied To Raised Sections of Cast Aluminum

HIGH lighting is a trade name given to the mechanical finish applied only to raised sections of castings, subsequent to the application of a base finish such as sandblasting or deplating, according to a bulletin, "Specifications for Architectural Finishes Applied to Aluminum Alloy Sand Castings," published by the Aluminum Co. of America, Pittsburgh. Several types of high lighting may be applied to these raised parts of a casting.

High lighting also may be accomplished in two general ways, namely, by a belt sander or rotary abrasive wheels. On flat castings the belt sander proves the most efficient while on irregular castings it is necessary to use wheels. Unless otherwise specified, high lighting will consist of the finish outlined using the type of equipment best adapted to the particular job.

The abrasive wheels recommended for high lighting are made from 6 to 12-inch standard sewed muslin buffs by gluing enough buffs together to give the desired thickness to the wheel. For general use, wheels 1½ to 2 inches thick are used. The size of the wheel depends upon the size and shape of the surface to be finished. Canvas, felt, leather, and composition sections may also be used in making up abrasive wheels.

Various grades of emery are used with these wheels depending upon the nature of the surface. The rough wheels use No. 60 to 120 emery while the fine wheels use from No. 140 to 180 emery, depending upon the fineness of the finish desired. The emery is applied to the wheel by painting the surface of the wheel with glue and then embedding the emery into the glue. After the emery has been applied to a wheel, the glue should be allowed to dry thoroughly before the wheel is used. Each new wheel should be broken down with a file before using to cut down the heavy cutting action of the fresh emery.

Polishing wheels of this type are used with horizontal high speed air grinders operated at from 3400 to 4400 revolutions per minute. If larger wheels are used the speed may be reduced to some extent and still maintain the same peripheral speed.

Wheels with No. 120 emery are used with buffing tallow. Wheels with No. 180 emery generally are used with a greaseless polishing compound. The life of the wheel depends upon operating conditions.

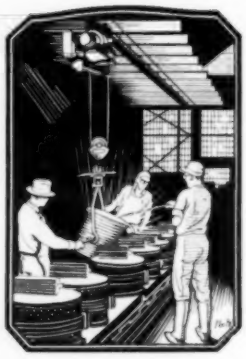
If higher polishes are desired, the surfaces may be buffed with a muslin or felt wheel and a polishing grease such as tripoli. A polished surface may be given a still higher colored lustre with a coloring process, using slaked lime or a coloring compound. High polishes are not necessary for exterior work, and in fact usually are not desirable because of their high light reflectivity.

Surface Absolutely Smooth

For plain flat surfaces that must be absolutely smooth and free from ripples, the belt sander is used. Emery cloth belts of No. 80, 120, 140 and 180 emery are used in the order given, depending on the finish desired. No. 0 buffing tallow and a small amount of machine oil are used as a cutting lubricant. A thin paste of paraffin and turpentine also makes a satisfactory lubricant. A belt sanded surface may also be buffed with muslin wheels and tripoli if a high polish is desired.

The wire brush finish generally is applied to castings after a fine or medium sandblast. The fine sandblast is preferred, but in cases where the surface is exceptionally rough it may be necessary to use the medium sand. A wire brush finish is applied by rotary wire brushes with various size wires, depending upon the fineness of the finish desired. Six to 10-inch diameter wire wheels are recommended using nickel, stainless steel, or German silver wires 0.006 to 0.014 inches in diameter. The speed of the wheel is quite important, the best results being obtained at 450-600 revolutions per minute. The wires of the wheel must be cleaned frequently with pumice stone or a soft brick to insure continued uniformity. The wheel should likewise be reversed on the driving shaft from time to time to keep the wires sharp.

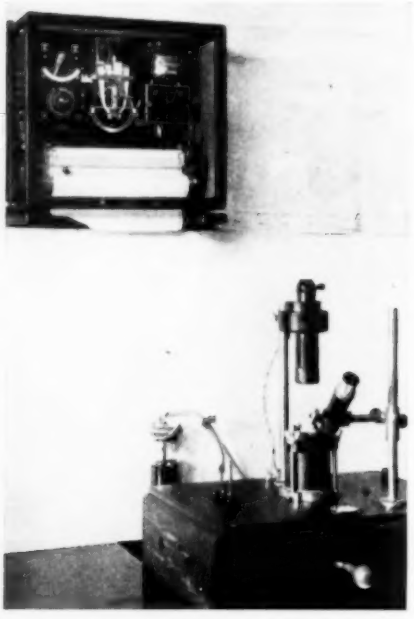
New Equipment



For Foundries

Instrument Gives Melting Point of Metals

An ingenious micropyrometer, under development at the Westinghouse research laboratories, determines the melting points and viscosity of metals and alloys with considerable accuracy. In operation a minute test piece of alloy is placed on the platinum strip, which is suspended from two insulated terminals, and current applied from the low-voltage winding of a step-down transformer. The heating chamber is gas-tight since the melting



Observation is made through a microscope

point determinations are made in various atmospheres or a vacuum. Observation is made by a microscope with a magnification of 100 to 1, through a clear quartz window. When fusion begins, the current is shut off.

Temperature is automatically recorded on a chart by an ardometer (total radiation pyrometer) which collects the heat rays passing through a quartz window and focuses them on a disk containing thermocouples leading to the recording instrument. Readings are taken in millivolts and read in degrees centigrade from a curve previously plotted of readings taken of metals of known melting points.

The instrument consists of a heating chamber in the form of a brass cap clamped by thumb screws to a brass base; a heating element, which is a platinum strip 0.5-inch wide and 0.0005 inch thick; a microscope for viewing the beginning of fusion; and an ardometer for registering temperature.

Control of the current is handled on the high-voltage side of the transformer; hence the current in the control apparatus is small. On the low-voltage side it has a range up to 40 amperes. A motor-driven rheostat, also operable manually, controls the voltage applied to the primary and provides a steady increase of current during a test.

Introduces Oxygen And Acetylene Regulators

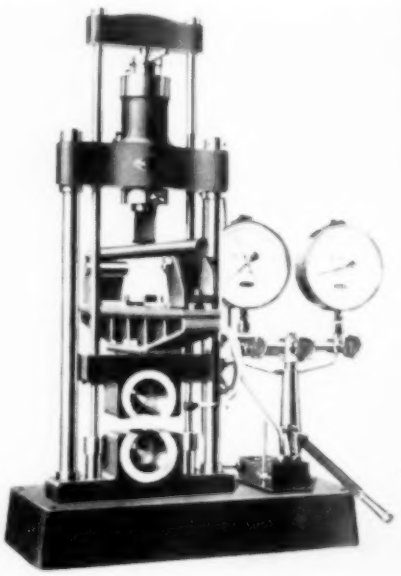
Linde Air Products Co., 30 East 42nd street, New York, has introduced a series of new oxygen and acetylene regulators. A feature of design is an accurate self-aligning valve of the nozzle and yoke type, to provide sensitive action and freedom from leakage. The diaphragms are made of a special corrosion-resisting alloy and a rupturing disk safety release on the oxygen regulator provides protection to the diaphragm in case of abnormal pressure. Gages on the new regulators are heavy to withstand rough usage in field work. One of the oxygen cutting regulators is shown in the accompanying illustration.

Heavy gages are used on the regulators

Machine Handles Numerous Physical Tests

A new testing machine for making tension, transverse, bending and compression tests recently has been placed on the market by the Steel City Testing Laboratory, 8843 Livernois avenue, Detroit. The accompanying illustration shows the machine equipped with a bending device.

The upper clamping head is adjustable vertically by a hand wheel to permit adjustment of working distance for tensile or compression tests. The load is measured with large precision pressure gages. To prevent shock at the rupture of the test piece the pressure gages are protected by a return shock valve. Two pressure gages provide for two different measuring ranges.



A special device is used for the transverse test

In the tensile and breaking tests, the bars are clamped with halved rings. The clamping heads are adaptable for testing all types of standard test bars and special extension clamping heads are provided for clamping short and small test bars. For compression tests, the

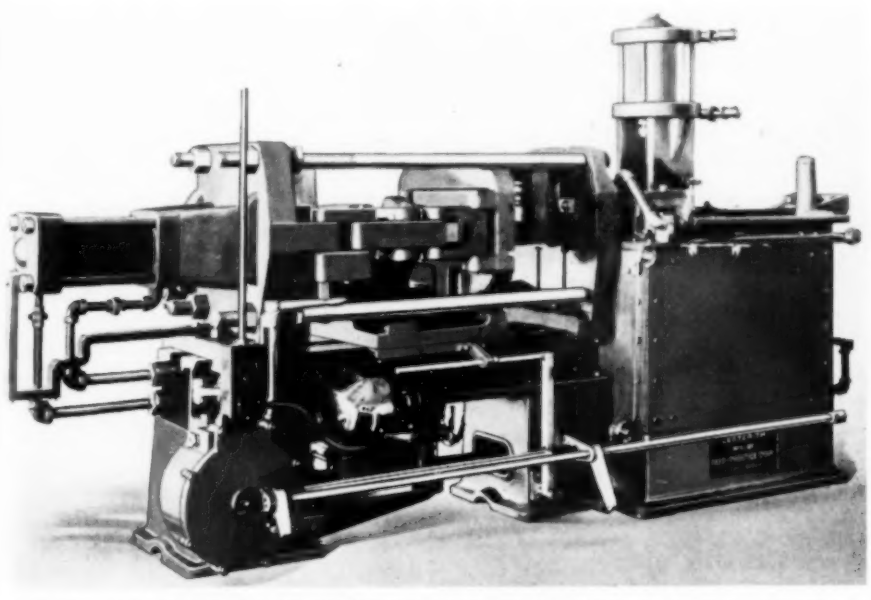
pieces are clamped between hardened pressure plates. For transverse tests of cast iron, a bending device is supplied, equipped with two sliding adjustable bending supports.

Casting Machine Operates Automatically

The Lester Die & Machine Co., Cleveland, has made a number of improvements in its hydraulic die casting machine which was developed about the middle of 1931. The earlier machine was hand operated, and the present machine is fully automatic. As may be seen from the accompanying illustration the machine is constructed rigidly, and develops a locking die pressure of 120,000 pounds. Metal is injected into the dies by the direct action of a pump, and through regulating the correct pressure and velocity of the metal, the air is scavenged completely from the die, producing dense castings with surfaces free from flow or swirl marks. Pressures in the neighborhood of 1500 pounds are used to force the metal into the die.

Elimination of water-cooling between the gooseneck and the die has resulted in a shortening of about 3 inches in the gate. That makes it possible to decrease the opening stroke of the machine by that amount, and permits more rapid operation of the machine through the lessened stroke and the lower amount of metal that has to solidify. Specifications for the machines show that the die opens 8 inches with a maximum die space of 17 inches and minimum space of 6 inches. The space between the bars is 12 x 16½ inches, and the average number of shots per hour is 250. The automatic control operates at 7 speeds producing from 150 to 450 castings per hour. Piston diameter of the metal pump is 4½ inches with a stroke of 7 inches.

The gooseneck capacity with a zinc-base alloy is 8 pounds and the pot capacity is 500 pounds. The length of the machine is 10 feet 8 inches, width 42 inches, height 50 inches, and shipping weight 7300 pounds. Larger machines with a gooseneck capacity of 25 to 30 pounds also are made. These will make from 50 to 250 castings per hour and have a maximum die space of 34 inches and minimum space of 16 inches with a locking pressure of 250,000 pounds. Reed-Prentice Corp., 41 Broad street, New York, is sales agent.



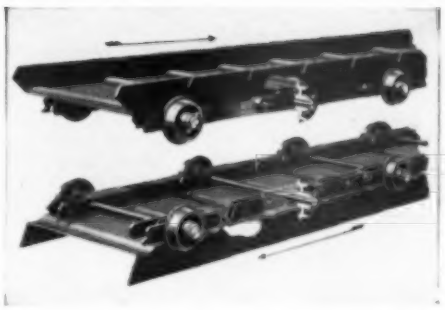
Metal is injected into the die under a pressure of 1500 pounds per square inch. Operation of the machine is entirely automatic

Portable Blower Is Driven Electrically

Breuer Electric Mfg. Co., Chicago, recently has introduced a portable electric blower which employs a ¼-horsepower motor from 32 to 250 volts. The motor is mounted on special bronze bearings and is built into a polished aluminum fan chamber.

The motor is mounted in a special aluminum fan chamber

The discharge outlet is ¾-inch in diameter. The blower is supplied with a rubber insulated nozzle, 20 feet of cord and an unbreakable rubber plug. The unit weighs 7 pounds.



The unit is designed to resist abrasive action

Construction of Conveyor Stops Leakage

Webster & Weller Mfg. Cos., 1856 North Kostner avenue, Chicago, recently developed a steel apron conveyor embodying a special feature of construction, based upon a new method of attaching the conveyor pans to the chains with pivot link. It is the operation of this link in connection with several minor construction features that causes the pans to overlap so snugly as to eliminate the possibility of leakage of material and yet provides sufficient flexibility to enable the conveyor to travel evenly and without strain around the sprockets.

Cross rods mounted through the center of the chain links are fitted with hardened bushings of unusual length. All roller parts may be quickly and easily replaced if they are broken, without unduly interfering with the operation of the conveyor. Each pair of rollers carries the load of two full pan pitches on both the carrying and return run of the conveyor, and rollers are idle only while the apron passes over the sprockets.

This new type of construction is applicable to both apron conveyors and apron feeders and has been developed primarily to withstand the abrasive action of material handled. The steel conveyor is shown in the illustration.

Develops New Metal

Revere Copper & Brass Inc., 230 Park avenue, New York, recently introduced a new bronze which is available in numerous shapes and as notched ingots weighing approximately 50 pounds each for sand casting. It is claimed that the alloy, known as Herculoy, will cast well in sand molds, chilled molds or centrifugally, provides a rich golden color, can be machined readily, has a tensile strength of around 5300 pounds per square inch and elongation in 2 inches of 28 per cent. It is pointed out that the alloy is applicable to corrosion resisting castings of high strength and toughness and for equipment in electrical installations.

Obituary

JOHN S. McCORMICK, 67, president and director, J. S. McCormick Co., Pittsburgh, died in an automobile accident at Harmarville, Pa., June 25. As the founder of that establishment engaged in the manufacture and distribution of foundry equipment, facings and supplies, Mr. McCormick was particularly active in the affairs of the foundry industry over a period of many years. In 1896, he was present at Philadelphia at the organization meeting of the American Foundrymen's association, and since that time he seldom missed an annual convention of that organization. He also was active in the Pittsburgh Foundrymen's association and served on several important committees of that group. He was a member of the Duquesne, University, Oakmont and Fox Chapel clubs of Pittsburgh.

Fred O. Rossiter, pattern shop foreman, Chain Belt Co., Milwaukee, died recently.

Herman Isay, 62, vice president, secretary and treasurer of the Allegheny Foundry Co. Inc., Pittsburgh, died at Hammond, Ind., June 22.

John M. Brown, 76, president and one of the founders of the Brown-Boggs Foundry & Machine Co. Ltd., Hamilton, Ont., died June 3.

William J. Akin, 78, formerly vice president and treasurer, Illinois Malleable Iron Co., Chicago, died in Evanston, Ill., recently. He had been identified with that company for 35 years, retiring three years ago.

George W. Page, 51, vice president, in charge of purchases and a director of the W. A. Jones Foundry & Machine Co., Chicago, died at his home on May 29. He had been connected with that company for 33 years.

James A. McDonald, 59, assistant to the president, Standard Sanitary Mfg. Co., Pittsburgh, died at Bellevue, Pa., June 4. He had been associated with the company for more than 40 years.

James A. Botsford, 70, treasurer of the Pittsburgh Malleable Iron Co., Pittsburgh, since 1912, died at Pittsburgh, May 9. He had been connected with the company for the past 30 years.

Fred J. Ahrens, secretary and treasurer of the Eberhard Mfg. Co., Cleveland, died May 14 at his home in that city. He had been with the Eberhard company for 33 years, first as bookkeeper, then credit manager for 20 years, and for the last three years secretary and treasurer.

William Passmann, 77, one of the founders and for many years president of the Loeffelholtz Co., Milwaukee, manufacturing brass castings, died May 16. He was born in Germany and came to America in 1882. Mr. Passmann retired 10 years ago.

J. H. Robinson, foundry superintendent, Michigan Valve Co., Detroit, and formerly connected with the Campbell-Wyant & Cannon Foundry Co., Muskegon, Mich., and the Clyde Iron Works, Duluth, Minn., as foundry foreman and foundry superintendent, died at Muskegon on June 15.

Luther D. Burlingame, 76, industrial superintendent, Brown & Sharpe Mfg. Co., Providence, R. I., died in that city June 2. A native of Whitesboro, N. Y., Mr. Burlingame had been a resident of Providence many years and active in civic affairs. He was president of

John S. McCormick

the Providence Safety council and a former president of the Providence Engineering society.

T. J. Thomsen, 76, founder, Thomsen Foundry Co., Duluth, died June 2. Mr. Thomsen worked at his trade in Chicago before going to Duluth in 1887, and in 1900 he started his own foundry. He is credited with being the first man to make an iron casting at Superior, Wis. The Thomsen foundry now is operated under the management of Mr. Thomsen's son-in-law, L. H. Syck.

James B. Herring, 66, chairman of the board of directors and one of the founders of the Ottawa Silica Co., Ottawa, Ill., died in Pasadena, Calif., recently. Mr. Herring is credited with a leading part in the development of the sand industry in Ottawa. Going there in 1901 as secretary, treasurer and general manager of the Ottawa Silica Co., which he and his brother, the late Charles B. Herring, had organized the year before, he directed the management of that concern from the small sand pit through its stages of growth to one of the nation's largest sand corporations.

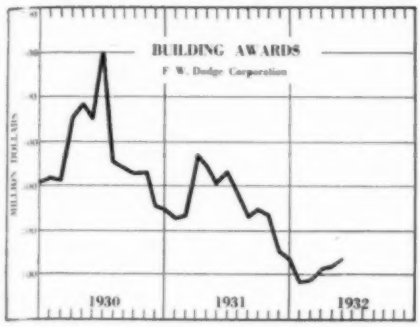
Elmer O. Lange, 36, production manager, South Side Malleable Casting Co., Milwaukee, until illness caused his retirement two years ago, died recently. He was born in Milwaukee, son of Fred A. Lange, founder of the South Side Malleable as well as the Crucible Steel Casting Co., and the brother of Walter W. Lange, president of the South Side, and Albert C. Lange, president of the Crucible company.

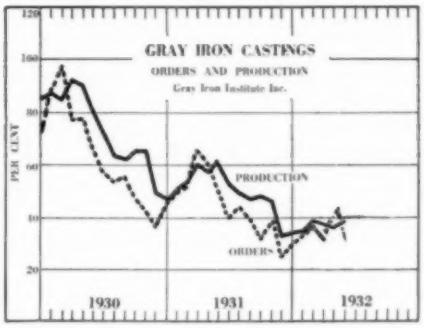
Donald M. Eddy, vice president, Hanna Furnace Corp., Buffalo, died June 10. Mr. Eddy became connected with the M. A. Hanna Co., Cleveland, as director of purchases in 1923 and later became associated with the Hanna Furnace Corp. In February, 1927, he was made eastern manager of sales of the Hanna Furnace Corp., Buffalo, and later was made vice president. In April, 1930, he was made vice president and director of the Donner-Hanna Coke Corp., and also a director of the Hanna Furnace Corp.

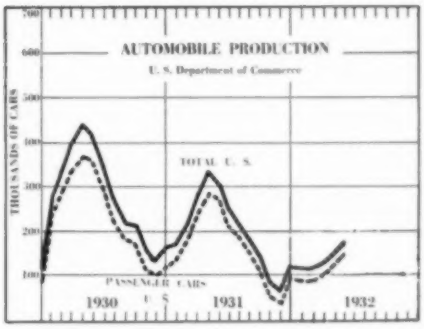
Col. C. C. Smith, 70, founder of the Union Steel Casting Co., Pittsburgh, died in Jacksonville, Fla., May 2. Colonel Smith began his industrial career as a clerk with the Carnegie Steel Co. and founded the Union Steel Casting Co. in 1899. He served as chairman of the board from 1918 to 1929. He was commissioned a lieutenant colonel during the world war being a member of the war claims board and served with the New York district for ordnance. He was also board chairman of the Pittsburgh Rolls Corp.

Francis E. Drury, 81, founder of the Perfection Stove Co., Cleveland, died at Augusta, Ga., recently. He was born in Pittsfield, Mich., in 1850 and entered the hardware business in Cleveland in 1870. In 1888 with H. P. Crowell he organized the Cleveland Foundry Co. Shortly afterward he became interested in the manufacture of the oil stove. In 1910 the Cleveland Metal Products Co. was organized and about 1924 this concern became the Perfection Stove Co. Mr. Drury was chairman of the board until 1930 and a director at his death.

Edward B. Leigh, 79, president Chicago Railway Equipment Co., Chicago, died May 17 at his ranch in Kerr county, Tex. Mr. Leigh became associated with the railroad industry at 15, when he joined the St. Louis office of the Pennsylvania railroad. In 1892 he organized the Chicago Railway Equipment Co., becoming vice president and general manager. In 1906 he was elected president. Mr. Leigh was a director of the National Association of Manufacturers, the Railway Business association and was a member of the National Industrial Conference board.







Foundry Activities

Reflect Industrial Trends

DANEY ALUMINUM & BRONZE CASTINGS CO., 2067 Caldwell drive, Toledo, O., has taken over the plant of the former Watson Machine Co., 3180 Bellevue road, and has equipped it for the operation of a foundry. Frank J. Daney, formerly superintendent, France Foundry & Machine Co., Toledo is owner and manager.

* * *

Ohio Steel Foundry Co., Lima, O., recently has installed new equipment including molding machines.

* * *

Morgan Stove Repair Foundry Co., Brooklyn, N. Y., has been incorporated by S. Dubin, 160 Broadway, New York.

* * *

A. M. Mattison Foundry & Pattern Works, Eau Claire, Wis., recently started construction of an extension 40 x 60 feet.

* * *

Sorel Steel Foundries Ltd., Sorel, Que., will build a plant addition and install new equipment. P. H. Desrosiers is manager.

* * *

Miller's Brass Foundry, 259 Hertel street, Three Rivers, Que., recently was practically destroyed by fire.

* * *

Art Aluminum Foundry, Chicago, has leased a plant at 3266 Elston avenue, and will move its operations to that point.

* * *

Chicago Malleable Castings Co., Chicago, has bought the right to manufacture a journal box and lid from the McCord Mfg. Co., Chicago.

* * *

Bethlehem Foundry & Machine Co., Bethlehem, Pa., has contracted with the Oil Electric Engineering Corp., Minneapolis to build the latter's equipment at Bethlehem.

* * *

Orilium Corp. Ltd., Toronto, Ont., has been incorporated to conduct a metalworking business and operate a brass and iron foundry, by William E. Gill, Toronto.

* * *

Portland Die Casting Co., 838 East Burnside street, Portland, Oreg., has been purchased by Allen E. Chisholm, who will operate it under the name of Chisholm Die Casting Works.

* * *

Gaffnay Foundry & Iron Works, Columbia, S. C., has been incorporated with $1200 capital to operate a foundry. D. H. Sher is president; R. L. Champion, vice president, and S. Robinson, secretary.

* * *

San Antonio Foundry Co., San Antonio, Tex., recently moved its new plant to 500 Blue Star street. N. M. Karney is president and E. J. Karney is vice president. The company was established in 1887.

* * *

Western Die Casting & Mfg. Co., has been organized in St. Louis with A. W. Altvater as president, to manufacture a general line of die castings. The new company has taken over the plant and equipment of the Anderson Die Casting Co., 4946 Southwest avenue, St. Louis.

* * *

Driver-Harris Co., Harrison, N. J., has been licensed by the International Nickel Co., New York, to melt and fabricate the corrosion resisting alloy Ni-Resist, which consists of a nickel-copper-chromium cast iron containing approximately 14 per cent nickel, 6 per cent copper and 2 per cent chromium, the balance of gray iron.

* * *

Advance Pressure Castings Inc., recently organized, has a plant at 34-48 North Fifteenth street, Brooklyn, N. Y. The company will specialize in die castings of zinc and aluminum base alloys. A. F. Waltz is president. Others associated with the company include W. Jensen, Alfred Rusch, R. Zaleskie, B. F. Dertinger and H. Bonzak.

RAW MATERIAL PRICES
July 6, 1932

Iron	
No. 2 foundry, Valley	$14.50 to 15.00
No. 2 Southern, Birmingham	11.00
No. 2 foundry, Chicago	15.50 to 16.00
No. 2 foundry, Buffalo	16.00
Basic, Valley	14.00 to 14.50
Basic, Buffalo	15.50 to 16.00
Malleable, Chicago	15.50 to 16.00
Malleable, Buffalo	16.50
Coke	
Connellsville beehive coke	$3.00 to 4.25
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$8.50 to 9.00
Heavy melting steel, Pitts.	8.00 to 8.50
Heavy melting steel, Chicago	5.25 to 5.75
Stove plate, Buffalo	6.75 to 7.00
Stove plate, Chicago	4.50 to 5.00
No. 1 cast, New York	5.00 to 5.50
No. 1 cast, Chicago	5.50 to 6.00
No. 1 cast, Philadelphia	9.00
No. 1 cast, Pittsburgh	8.50 to 9.00
No. 1 cast, Birmingham	6.50 to 7.00
Car wheels, iron, Pittsburgh	8.50 to 9.00
Car wheels, iron, Chicago	5.50 to 6.00
Railroad malleable, Chicago	6.00 to 6.50
Agricultural mal., Chicago	5.25 to 5.75
Malleable, Buffalo	8.00 to 8.50
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	5.12½
Straits tin	20.87½
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt	7.00 to 8.00
Lead, New York	2.75 to 2.85
Antimony, New York	5.00
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	2.60 to 2.65

New Trade Publications

ALLOYS—Electro-Alloys Co., Elyria, O., has issued bulletin No. 100 on its heat-resisting and corrosion-resisting alloys.

SCREENS—Traylor Vibrator Co., Denver, Colo., has published a four-page folder illustrating four types of screens for various industrial uses.

DIE STEEL—Physical properties and characteristics of an air-hardened die steel are contained in a recent four-page leaflet published by the Ludlum Steel Co., Watervliet, N. Y.

HEATING SYSTEM—A new type of heating boiler is described and illustrated in a recent folder of the O. W. Werntz Foundry & Machine Works, Warsaw, Ind. Radiators manufactured by that company also are shown.

ELECTRICAL RESISTANCE MEASUREMENTS—Leeds & Northrup Co., 4901 Stenton avenue, Philadelphia, has published catalog No. 40 discussing its line of apparatus for electrical resistance measurements.

REFRACTORY—A bulletin by Laclede-Christy, St. Louis, discusses a new refractory called mullite which it is claimed is nonspalling, nonshrinking, resistant to slag action, and has high load bearing capacity.

BUCKETS — Wellman Engineering Co., Cleveland, in a current bulletin features one of its buckets for digging, rehandling and other uses. Features of construction are illustrated and advantages described.

GENERATING SETS—The Troy Engine & Machine Co., Troy, Pa., has published a bulletin entitled "How Six Representative Concerns Cut Power Costs." The booklet includes descriptions of steam engines and generating sets built by that company.

CEMENTS—Technical Products Co., Pittsburgh, has published a general catalog on adhesive, acid-proof cement, insulating material and iron fillers. The company makes cements which are recommended for heat treating and localized carburizing operations.

RUBBER—B. F. Goodrich Rubber Co., Akron, O., has prepared for distribution a booklet on rubber, entitled "A Wonder Book of Rubber." It is not offered as a scientific discussion but to give general information on the rubber industry.

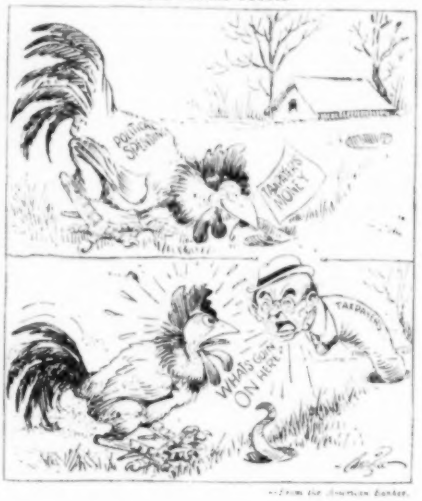
CLUTCHES—Magnetic Mfg. Co., Milwaukee, describes its line of multiple disk magnetic clutches in bulletin No. 50. This is a recently developed clutch and the bulletin gives complete technical data on features and characteristics.

ALLOY CASTINGS—Standard Alloy Co., Cleveland, in bulletin No. 21 describes its standard alloy castings for heat and acid resistance. Various analyses are given, with accompanying data to guide to the proper alloy for a given use.

HARDNESS TESTERS—R. Y. Ferner Co., Investment building, Washington, is distributing catalog No. H-1, describing two types of portable hardness testers, a pendulum type and a brinell press, each adapted to shop use for quick testing of materials.

POWER DRIVE EQUIPMENT—Hill Clutch Machine & Foundry Co., 6400 Breakwater avenue, Cleveland, is distributing its catalog 29-A. Listing shafting, collars, shaft couplings, jaw clutches and many styles of bearings for vertical, horizontal and agitator shafts.

THE WORM TURNS



AIR FILTERS—American Air Filter Co. Inc., Louisville, Ky., recently has published a 24-page booklet discussing industrial dust problems and application of its line of air filters for industrial air conditioning. Specific installations are described and illustrated.

DUST COLLECTIONS—Framed bag dust collectors are described in detail in a recent publication of Blaw-Knox Co., Pittsburgh. Information includes details and construction features, cleaning mechanisms, housing, methods of changing cloth bags, and supplementary equipment.

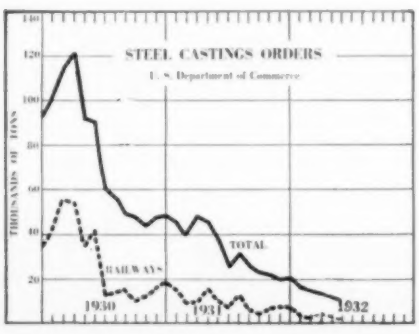
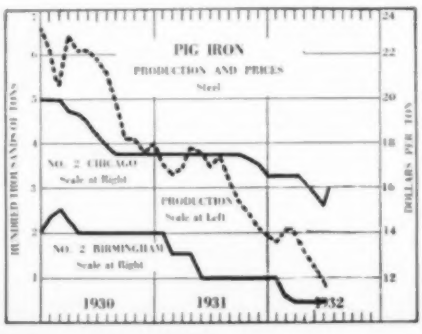
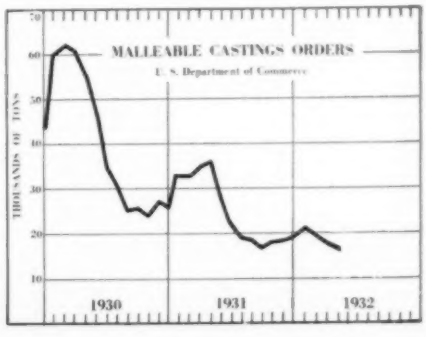
ARC WELDERS—General Electric Co., Schenectady, N. Y., in bulletin No. 1543 describes and illustrates a line of gas-engine-driven arc welders in 200, 300, 400 and 600 ampere capacities. Information on the gas engine drive and dimensions and weight of the entire welding unit are given.

PROPELLER FANS — Ilg Electric Ventilating Co., 2850 North Crawford avenue, Chicago, has prepared a catalog describing its line of fans and blowers for ventilating practically any type of building or industrial process. Information on capacities and specifications also is given. The company also has prepared a folder illustrating its portable type air cooling machine.

OPTICAL PYROMETER—A discussion of the measurement of temperature by the optical pyrometer, a description of the optical pyrometer manufactured by the Bacharach Industrial Instrument Co., 7000 Bennett street, Pittsburgh and the method of operation of that pyrometer are included in bulletin No. 296 recently published by the Bacharach company.

SPEED REDUCERS—Westinghouse Electric & Mfg. Co., Pittsburgh, has issued a leaflet No. 20536 on its gearmotors, which are speed reducers compactly combined with induction motors, forming general purpose unit drives. The leaflet contains information on the application and operation, details of construction, sizes and speeds and tables of dimensions.

UNIT HEATERS — American Foundry Equipment Co., Mishawaka, Ind., has published a bulletin illustrating and describing the construction of its heating element used in its line of electric unit heaters. In the element, special heating strip are cast integrally with composite fins of aluminum alloy. A list of applications for the heater also is included.

TESTING MACHINE — Baldwin-Southwark Corp., Southwark division, Philadelphia, in bulletin No. 28 presents a short textbook on hydraulic testing machines, written about the Southwark-Emery testing machine. The history of that type of machine is given as an introduction and the various features of its construction then are described. Illustrations present various types of machines and of indicating and recording devices for use with them.

ALUMINUM-SILICON ALLOY—Metropolitan-Vickers Electrical Co. Ltd., Trafford Park, Manchester, England, has published a booklet on its new aluminum silicon alloy. Information presented includes physical properties, composition and structure, strength, ductility, resistance to corrosion, foundry and working properties, machinability, etc. The booklet is well illustrated with micrographs, photographs of fractures and various types of castings made from the alloy.